MECHANICAL ENGINEERING

February, 1958

A Fund-Raising Organization for the Engineering Profession

The Riding Comfort of Railroad Passenger Cars

Straightening Vanes for Flow Measurement

Characteristics of the Creative Engineer

Developing Creativity in Engineering

The Potential Machine Designer

Portland Generating Station

Nuclear Power in Britain

Complete Contents on Pages 3 and 5

Pressure Vessel for Nuclear Power

Dunlop Cuts Steam Cost 23½% Per Tire

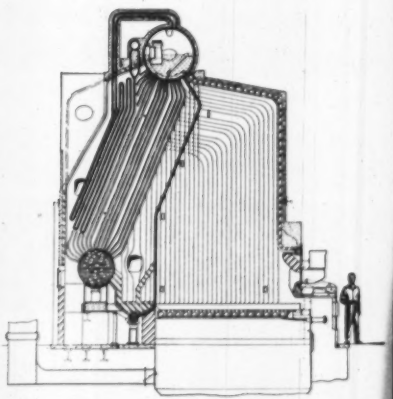
New B&W FP Boilers Burn Less Coal ... Supply Higher Temperature Steam

At Dunlop Tire & Rubber Company's Buffalo Plant, these big, modern curing presses are stepping up tire production. But they need plenty of dependable steam at fairly high temperature. The boilers they had couldn't do the job so they installed two new B&W Integral-Furnace Boilers.

These new boilers not only supply that "increased production" steam, but burn less coal and generate more steam than the old boilers, using the same limited space—a combination that cuts steam cost per tire 23½%.

Dunlop installed its first six B&W units in 1920, when the Buffalo Plant was new. Although still capable of reliable service after 37 years, the higher steam temperature demand of modern tire making has marked the four remaining old boilers for early replacement by more efficient B&W FPs.

Dunlop's experience with B&W boilers is typical of thousands of industrial, utility, commercial and institutional users. So if you use steam for power, processing or heating ... if you want to modernize or expand your plant ... if you have a steam plant problem of space or fuel or fly ash ... call B&W and get the benefit of 90 years of steam experience. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.



Each B&W FP unit can supply 40,000 lb of steam per hr at a pressure of 260 psi and temperature of 505 F. New boilers were specially designed to fit space used by old units they replaced. Zack C. Hinds, Buffalo, New York, was the Consulting Engineer on the project.

G-801-18

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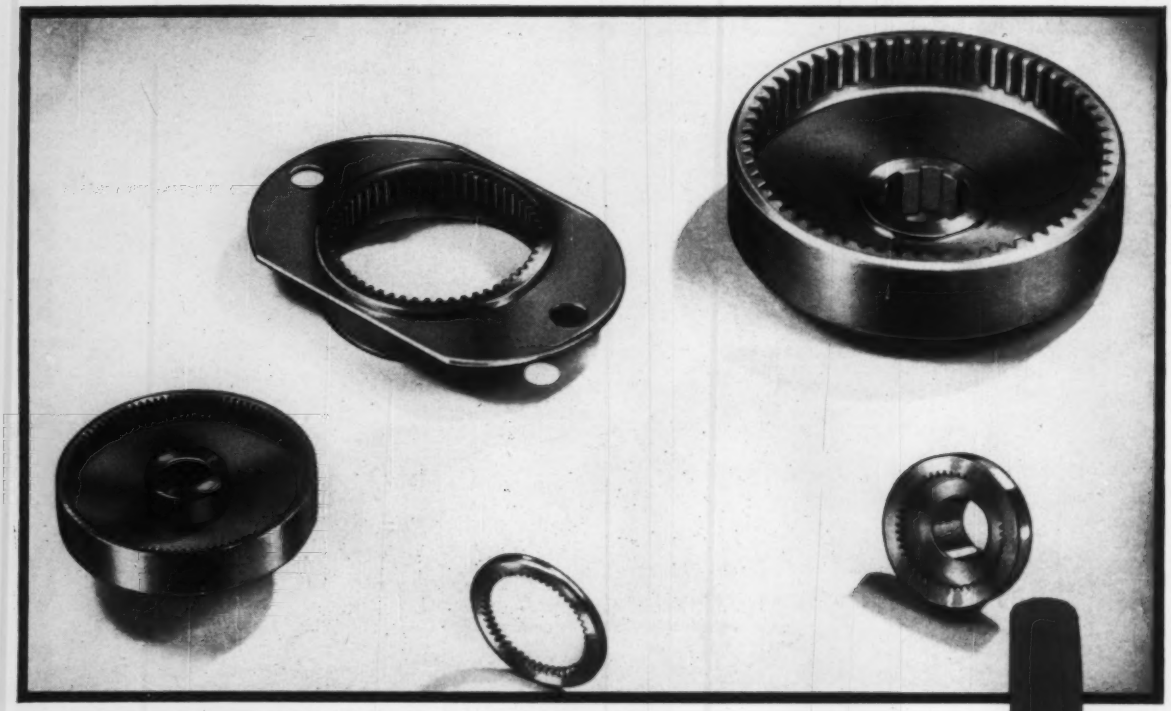

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SEND FOR *G.S. technical data, free! See where and how we mass-manufacture Small Gearing to uniformly fine tolerances. Folder contains 23 pictures of Small Gears, plant view, as well as Diametral and Circular Pitch Tables. Ask for your copy on company stationery.*

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Contents

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EDITORIAL DEPARTMENT

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THE COVER

Welding multiwall tubing. For this sodium-type, nuclear-power pressure vessel, one stainless-steel tube is arranged concentrically within another, to provide an annulus for a monitoring fluid—a complex weld. Photo from Combustion Engineering, Inc., Chattanooga Division, Chattanooga, Tenn.

FUNCTIONAL ORGANIZATION FOR THE ENGINEERING PROFESSION.....W. J. Barrett 57

As an engineer, you may feel concern about your profession and its responsibilities. Here's how your leaders are moving to bring solidarity and new professional standards to engineering.

NUCLEAR POWER IN BRITAIN.....W. R. Wootton 60

Bit of a fuel deficit: That's England's coming problem, and the British are ready. At Calder Hall they've a nuclear power plant already in operation that's economical, reliable, and safe.

PORTLAND GENERATING STATION.....J. G. Miller and R. H. Kreisinger 64

Here's the latest on steam: A steam-electric power plant with monotube boiler (new in this country); something different in turbines; and a radical concept in combustion control.

STRAIGHTENING VANES FOR FLOW MEASUREMENT.....R. E. Sprenkle and N. S. Courtright 71

Bringing new accuracy to flow measurement. A new type of flow straightener has been tested. It uses separated plates, and it produces uniformly turbulent flow at an orifice.

DEVELOPING CREATIVITY IN ENGINEERING.....D. G. Taylor and R. C. Jordan 74

A student said, "This is the first actual invention ever explained to me." An experimental course at the University of Minnesota fosters creative ability. A new kind of college course.

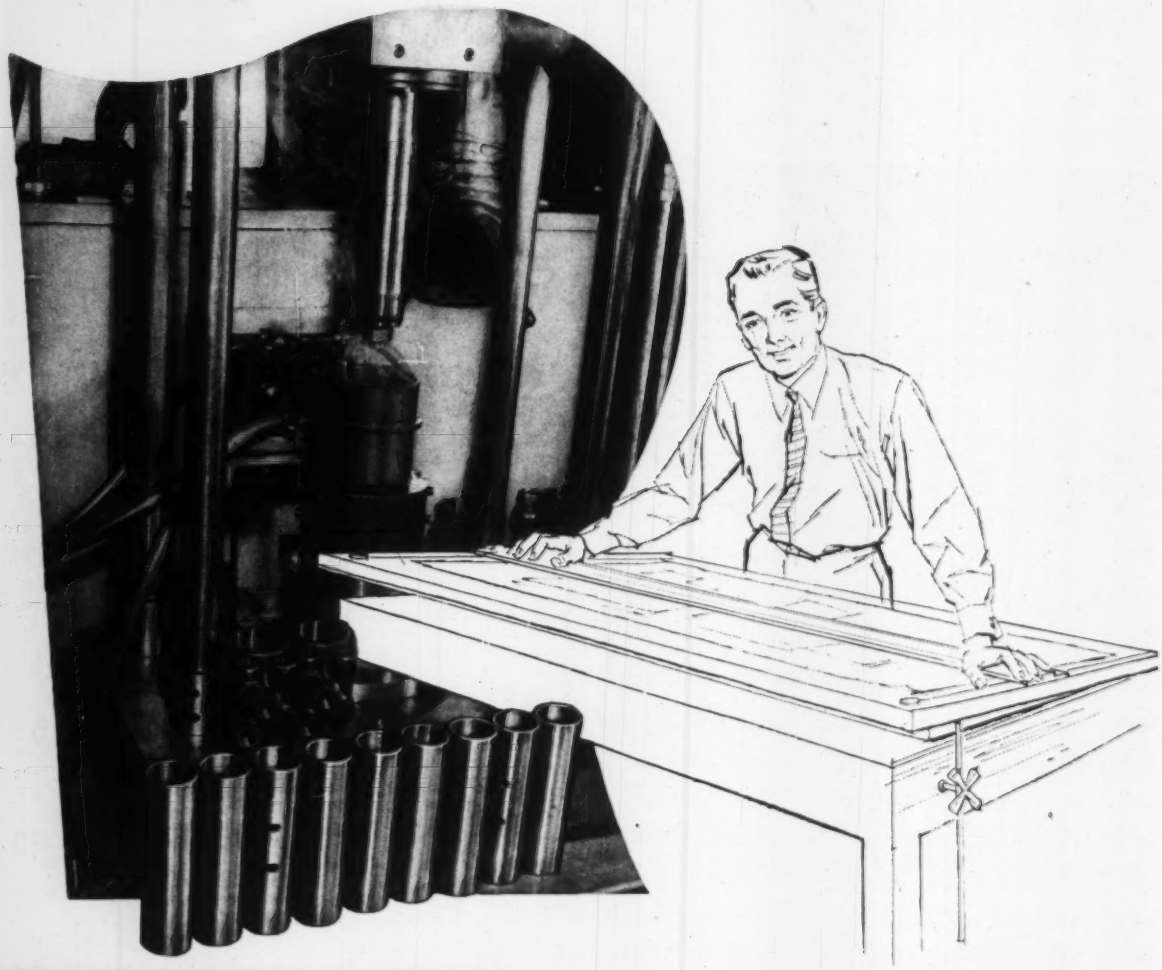
THE POTENTIAL MACHINE DESIGNER.....J. F. Downie Smith 76

That new man: Has he got creativity? Could he conceive and plan a new machine? Iowa State College is developing aptitude tests to spot the creative undergraduate. We need designers.

CHARACTERISTICS OF THE CREATIVE ENGINEER.....G. J. Spencer 78

To be creative: First, arrange to be compulsive, smart, and a controlled dreamer. And rebellious—for only such men invent new machinery. You must have these qualities in balance.

Contents continued on following page



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Contents (continued)

VOLUME 80 • NUMBER 2 • FEBRUARY, 1958

RIDING COMFORT OF RAILROAD PASSENGER CARS ..... W. E. Burdick 81

Going by train? Under your car will be modern trucks with coil springs, fabric damping pads, off-tread brakes. You'll notice roll stability, soft lateral action. Here's how it's done.

Departments

EDITORIAL 55

BRIEFING THE RECORD 85

12-Mill Nuclear Power? 85
New Ductile-Iron Process 85
Basic-Oxygen Process 86
"Sandwich"-Rolling Process 87
Powder-Metallurgy Process 88
New Computer 88
Machine-Construction Kit 89
90 Pressure Cells
90 Steel Industry
90 Dynamic Testing Wind Tunnel
91 Gas Liquefaction
92 Missile Miscellany
93 Nuclear Briefs
94 Materials Briefs

PHOTO BRIEFS 96

Airplane Turntable 96
Midget Submarine 97
Lead-Brick Wall 97
Compression Fittings 97
97 Built-in Tie Wires
97 Water-Wheel Developing
97 Snark Production
97 Continuous Copper Plating

EUROPEAN SURVEY 98

Large Milling and Boring 98
Portable Gear-Testing 98
99 Long-Running Thermal Precipitator for Mine Dust

ASME TECHNICAL DIGEST 100

Aviation 100
Fluid Meters 103
Heat Transfer 104
Applied Mechanics 106
Wood Industries 107
109 Management
109 Metal Processing
110 Hydraulics
111 ASME Transactions for January, 1958

COMMENTS ON PAPERS 112

REVIEWS OF BOOKS 115

BOOKS RECEIVED IN LIBRARY 118

ASME BOILER AND PRESSURE VESSEL CODE 119

THE ROUNDUP 123

UET Report 123
Nuclear Congress 126
Power Conference 127
IMechE Meetings 127
Combustion Engineers Congress 128
AMA Salary Report 128
E. R. Needles States 129
129 World Petroleum Congress
130 People
131 Coming Meetings
131 Literature
132 Industrial Films
132 Meetings of Other Societies
132 Education

THE ASME NEWS 134

Meetings 134
Aviation 135
Textiles 137
Wood Industries 138
Maintenance and Plant Engineering 138
Instruments and Regulators 139
RAC Meetings 140
Automatic Techniques Conference 140
140 Applied Mechanics Conference
140 Materials Handling Handbook
141 Junior Forum
142 ASME Standards Workshop
143 ASME Coming Events
143 ASME Executive Committee
144 Personnel Service
146 Candidates
148 Obituaries

KEEP INFORMED 153
CLASSIFIED ADS 217
224 ..... CONSULTANTS
226 .... ADVERTISING INDEX

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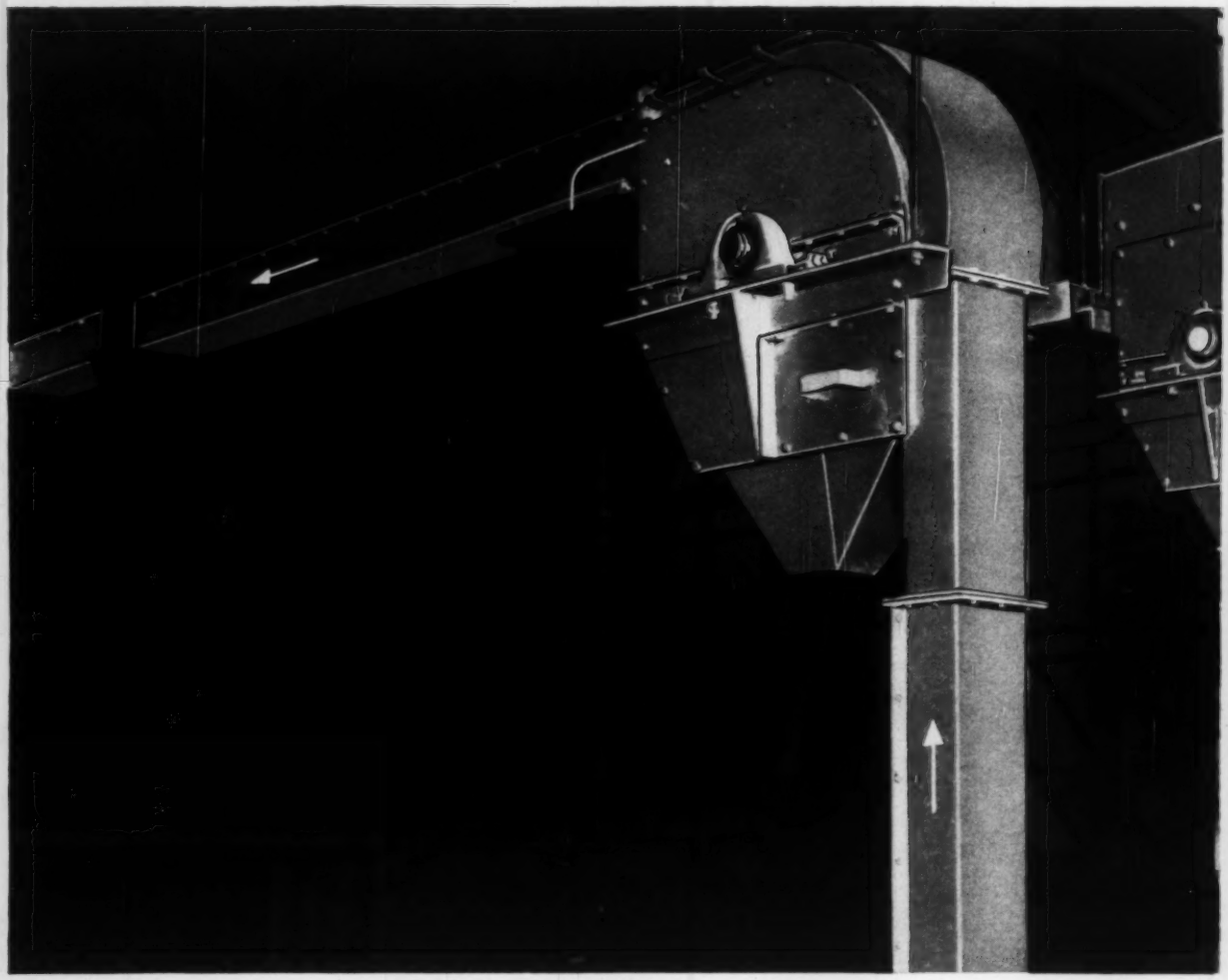
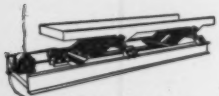


Flour is handled by these compact REDLER units, serving two production lines. Since their installation, production has been boosted three times over.

STEPHENS-

THE BIG NAME IN BULK MATERIALS HANDLING



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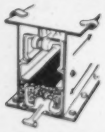

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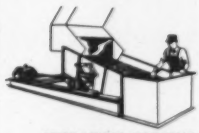
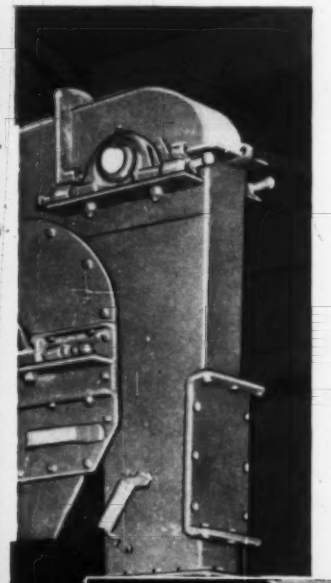


VIBRATING SCREENS

your best bulk materials handling move



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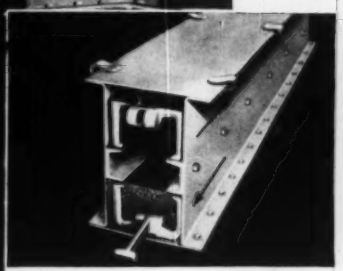
CONVEYORS-ELEVATORS

The REDLER Conveyor-Elevator is one ot the most remarkable bulk materials handling machines ever built. It will move practically any pulverized, granular, small lump, or flaky material around corners, over vertical, inclined, or horizontal planes. Material moves forward in a compact column within a totally enclosed, dust-tight casing which virtually eliminates explosion hazards. Material is moved by means of closely spaced skeleton type flights linked together and moving through the casings. Material flows forward in a compact column. A very useful feature of the REDLER Conveyor, is its ability to discharge material at multiple points. When arranged as a horizontal closed-circuit unit, the REDLER Conveyor will re-circulate materials and is often used in packaging or distributing operations.

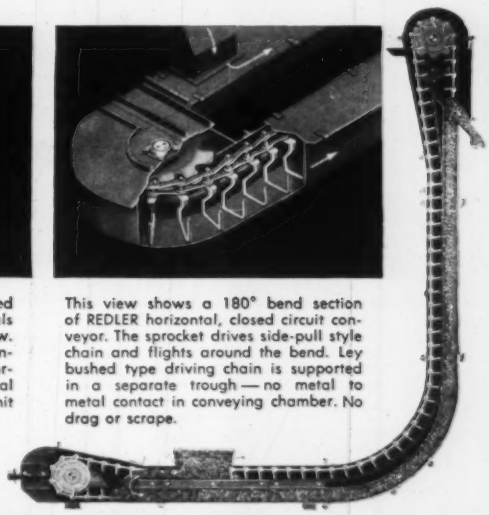
Compact REDLER Conveyor-Elevator designs are available in sizes to handle almost any tonnage. They are quickly and economically installed and their rigid box-girder-like casings are practically self-supporting. For complete data on REDLER Conveyors and Elevators, write for catalog 556.



Cross section thru the REDLER conveyor casing shows material being conveyed in a lower run and the empty flights returning in upper run to complete the circuit. The casing is completely dust-tight, is largely self-supporting and requires very little space. REDLER units are self-cleaning.

Exclusive, skeleton type flights, linked together, are used to move materials forward in a steady, non-agitated flow. REDLER flights, linked together in continuous chain, readily curve around corners permitting horizontal and vertical movement of materials with one unit and one drive.

This view shows a 180° bend section of REDLER horizontal, closed circuit conveyor. The sprocket drives side-pull style chain and flights around the bend. Ley bushed type driving chain is supported in a separate trough — no metal to metal contact in conveying chamber. No drag or scrape.



*The REDLER conveyor is an exclusive Stephens-Adamson product.

-ADAMSON

EQUIPMENT

S-A district or main plant offices can supply complete information on any conveyor product, or any phase of bulk material handling. Call or write for a copy of REDLER catalog 556 for your file.

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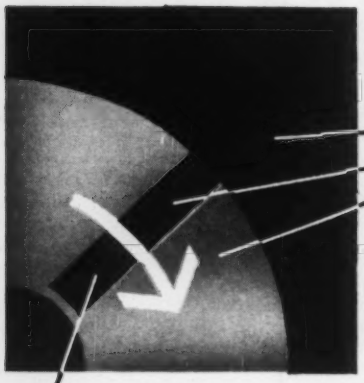
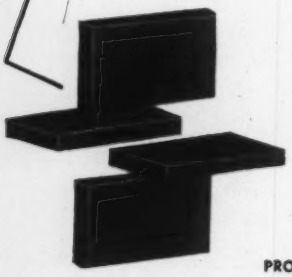
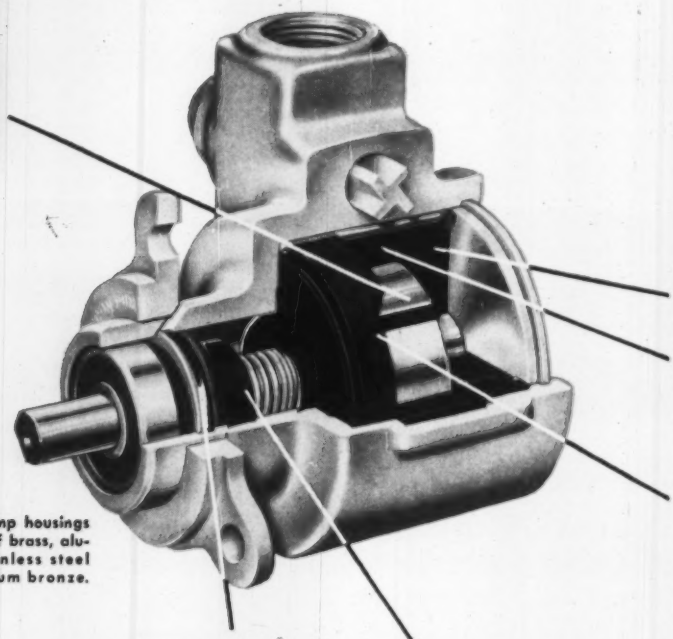
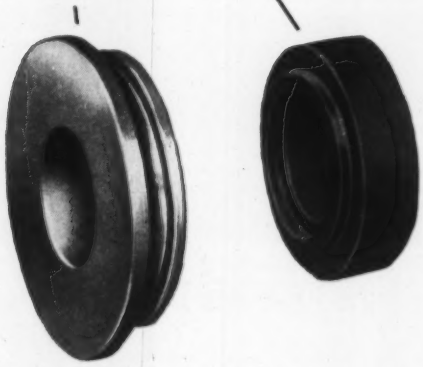






PROCON pump housings are forged of brass, aluminum, stainless steel and aluminum bronze.

GRAMIX seal-ring retainer



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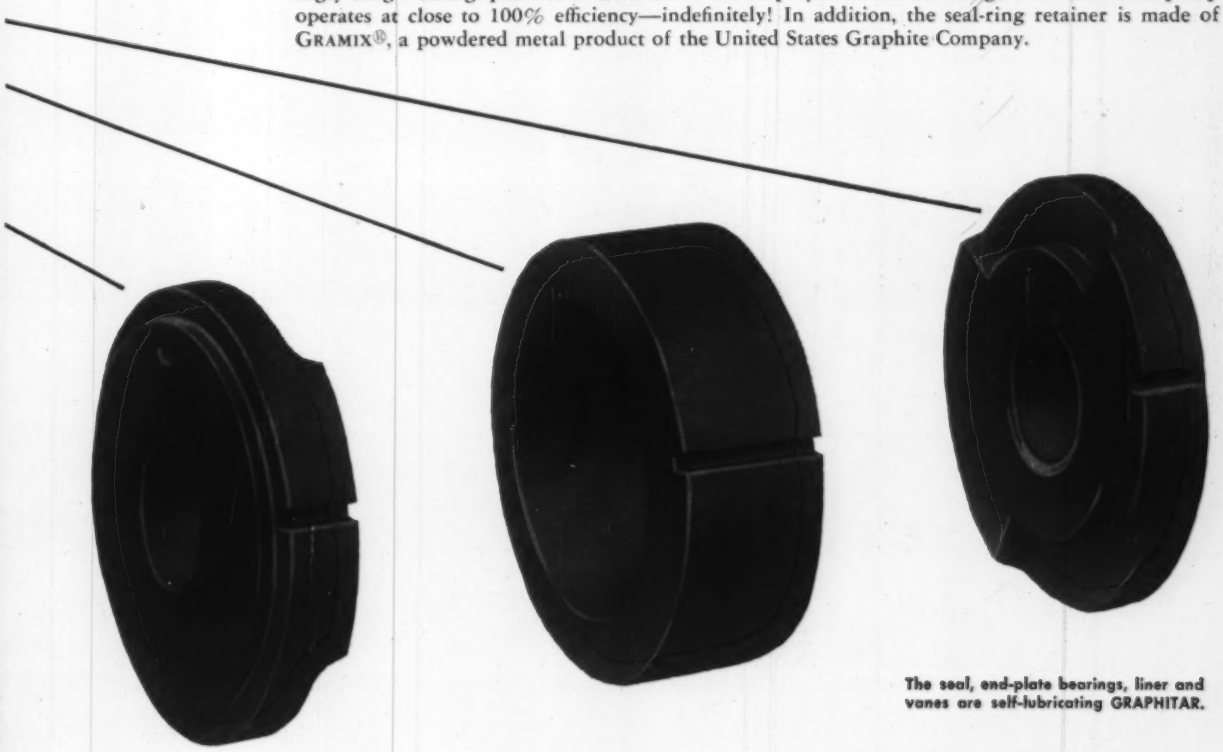
gives PROCON PUMPS amazing performance in handling *ALL TYPES OF FLUIDS*

10¢ dropped in a beverage machine in Minneapolis actuates a pump that fills a paper cup with syrup and carbonated water; a Utah dentist flicks a switch that starts a vacuum pump used in molding dentures; in a manual training school in North Carolina, a pump circulates the ammonia in a blueprint machine.

Mixing soft drinks . . . pumping chemicals, ethyglycol, ammonia . . . even pumping hot fats at the rate of 275 gallons an hour at pressures up to 300 psi, is the every-day work of the dependable little Procon pump, manufactured by the Procon Pump and Engineering Company of Detroit, Michigan. The liner, vanes, end-plate bearings and the seal ring of this versatile, high performance pump are made of GRAPHITAR. The four GRAPHITAR rotor-vanes run directly against a GRAPHITAR liner. By running GRAPHITAR against GRAPHITAR the self-lapping, self-lubricating and astonishingly long-wearing qualities of GRAPHITAR are employed to full advantage . . . the Procon pump operates at close to 100% efficiency—indefinitely! In addition, the seal-ring retainer is made of GRAMIX®, a powdered metal product of the United States Graphite Company.



The seal, end-plate bearings, liner and vanes are self-lubricating GRAPHITAR.

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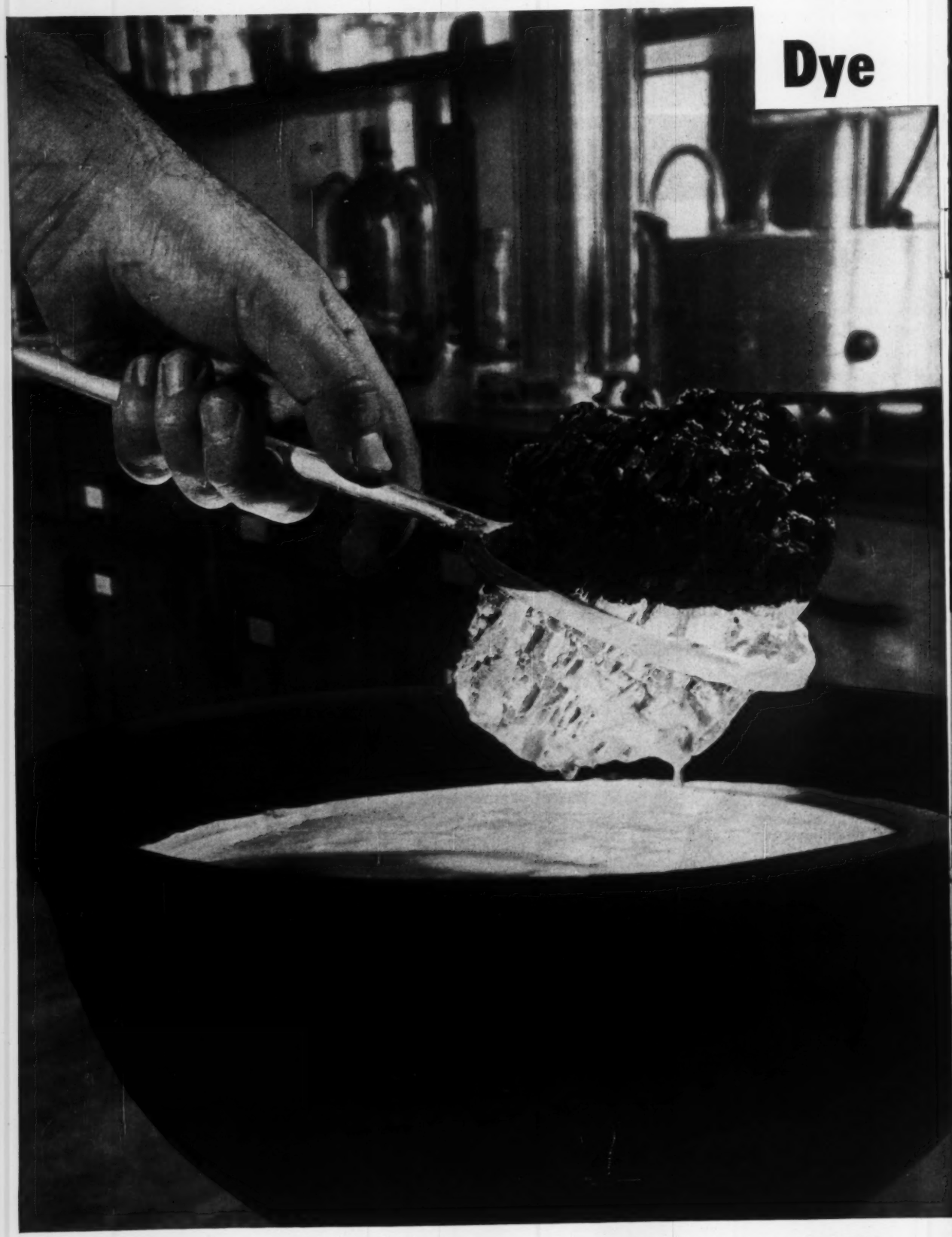
Dye

maker brightens fuel cost picture

Burning coal at Toms River-Cincinnati saves 20% on fuel costs, permits clean steam generation

The Toms River-Cincinnati Chemical Corp. plant in Toms River, N.J. is the most modern plant of its kind in the world. Producing vat dyestuffs requires a large dependable steam supply for chemical processes and heating purposes. To fill these requirements, the power plant at Toms River-Cincinnati is as up-to-date and efficient as the general plant itself. The fuel used for steam generation is *coal* because, on the basis of cost per thousand pounds of steam, the nearest competitive fuel costs 20% more than coal. In addition, thanks to automatic operation and modern equipment, the power plant meets the rigid standards of cleanliness required in such manufacturing operations.

Facts you should know about coal

Not only is bituminous coal the lowest-cost fuel in most industrial areas, as in the case of Toms River-Cincinnati, but up-to-date coal burning equipment can give you 15% to 50% more steam per dollar. Today's automatic equipment pares labor costs and eliminates smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at stable prices.

Technical advisory service

The Bituminous Coal Institute offers a free technical advisory service on industrial fuel problems. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to the address below. Or send for our case history booklet, complete with data sheets. You'll find it informative.

Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—will effect great savings for you in efficiency and fuel economy over the years.

BITUMINOUS COAL INSTITUTE

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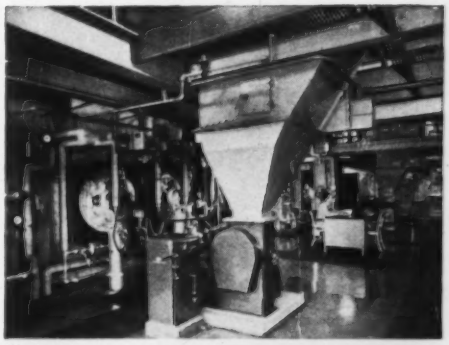
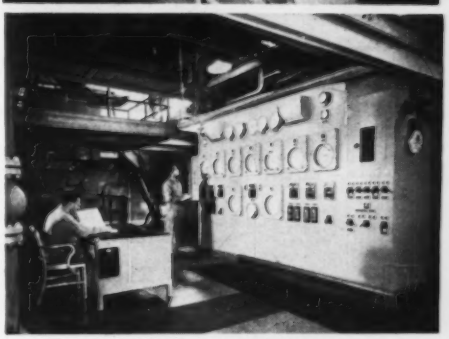
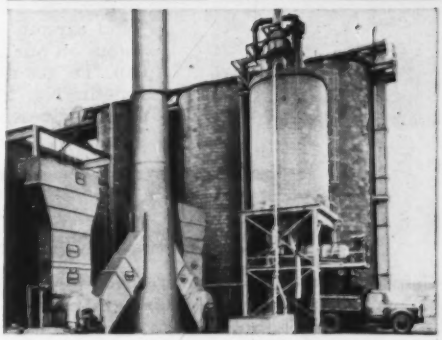


View of boiler room showing both 50,000 lbs. hr. boilers, by Riley Stoker Corp. Each has two burners. Center foreground is automatic weigh scale, by Richardson Scale Co., which receives coal through hopper from live storage bin and passes it to coal feeder. Coal is fed to Riley Pulverizer in basement, then blown back up to burners.

Close-up of Gifford-Wood Roundabout Bucket Conveyor beneath coal storage silos. Transversing feeder-car is used when coal is emptied from silo and conveyed to live storage bin.

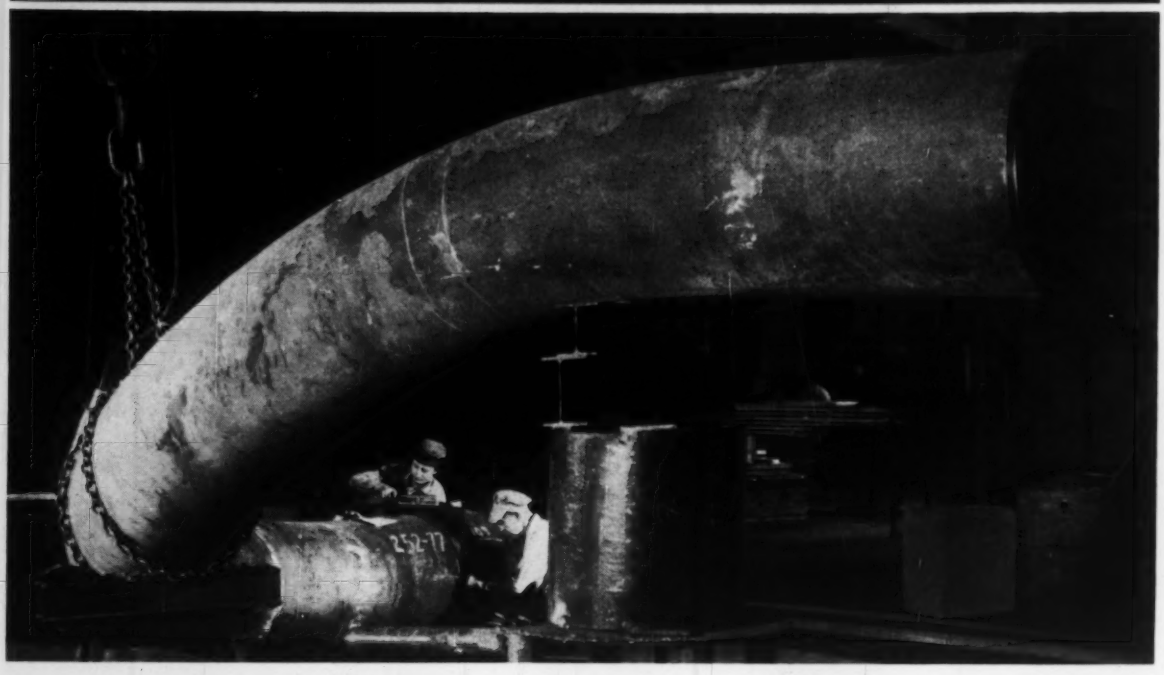


Automatic combustion control and instrument panel by Bailey Meter Co.



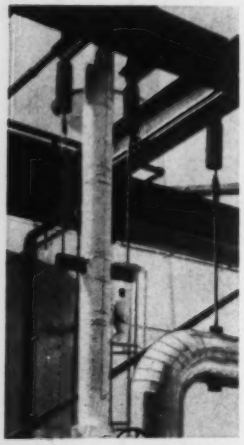
Fly ash being loaded on truck through a dustless rotary unloader. Fly ash is collected by Prat-Daniel Mechanical Precipitators. A pneumatic ash collecting system by United Conveyor (with tie-ins under air heater and at base of stack) removes it to this 20-ton ash silo. In the rear are three 330-ton coal silos.

BLAW-KNOX has what it takes—to provide these products and services



Large chrome moly pipe being readied for shipment to new generating station. Making a right angle bend followed by a 24 degree, 18 foot bend in this heavy 27½ inch chrome moly pipe required all the skill and modern facilities of the Blaw-Knox power piping shop. Before shipment, piping is heat-treated and ultrasonically tested with a radar-type device for detection of any defects.

A new Blaw-Knox "6 x 6" Flexibility Matrix Method of computing stresses in power piping systems is now available to consulting engineers, companies, and individuals responsible for the design of power piping systems. By the use of an electronic computer this method cuts calculating time from months to a day; assures full accuracy to six significant figures; and has no limitations on the complexity of the system. Write for further information about our new "6 x 6" Flexibility Matrix Method.



Two-way control over movement of piping is provided by Blaw-Knox functional spring hangers with the patented internal swivel action—shown in this modern outdoor generating station. Our experienced engineers are available to both design and make recommendations for your hanger requirements. To get full information, write for Catalog No. 54.

Each year serious fire strikes one out of every seven manufacturing firms in this country. Be safe. Let a Blaw-Knox fire-protection engineer study your needs —and explain how you can pay for the system on our lease or deferred payment plan. To get more information send for Bulletin No. 2426—"Fire Can Destroy Your Business."

BLAW-KNOX

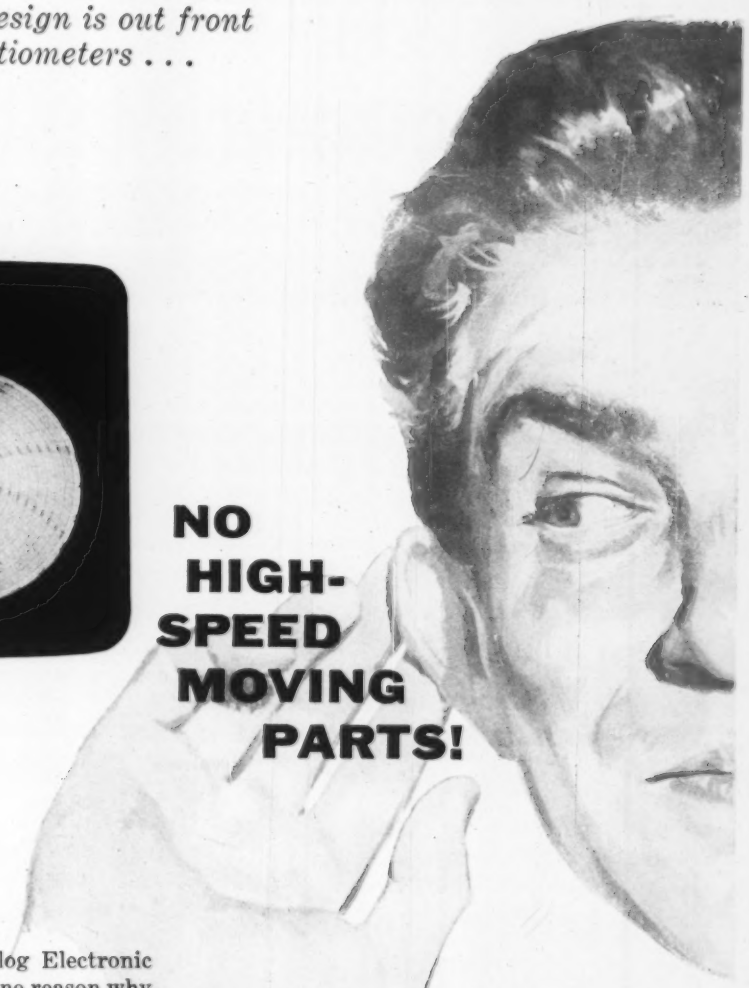
BLAW-KNOX COMPANY

Power Piping and Sprinkler Division

829 Beaver Avenue • Pittsburgh 33, Pennsylvania

Complete facilities for prefabrication and erection of piping systems for all pressures and temperatures
. . . complete line of standard and custom-engineered pipe hangers, supports and vibration eliminators
. . . complete line of automatic sprinkler systems for standard and special hazards

Why **DYNALOG*** *design is out front of all electronic potentiometers . . .*



NO HIGH-SPEED MOVING PARTS!

Just stand near an operating Dynalog Electronic Instrument, and you'll quickly learn one reason why it gives longer sustained accuracy and maintenance-freedom than other balancing-type process control instruments!

There's none of the usual buzzing and clicking, because Dynalogs have no slidewire or fast-moving parts. Instead, a simple, variable radio-type capacitor with silent magnetic drive gives *stepless* continuous balancing — smoother, faster response — without noise, waste motion or wear.

In addition, this unique Dynalog Design is inherently free from "drift" . . . has no dry cells to standardize or replace . . . requires no lubrication or realignment . . . insures years of trouble-free performance without continual "policing". Dynalog Recorders and Controllers are used with any primary element . . . resistance, voltage, capacity, inductive. For the complete story, write for Bulletin 20-10. **The Foxboro Company, 962 Neponset Avenue, Foxboro, Massachusetts, U.S.A.**

*Reg. U. S. Pat. Off.

Advance features to improve control of temperature, pressure, flow . . .

1. No periodic maintenance
2. No dry cell—no standardizing
3. No high-speed moving parts
4. No slidewire or galvanometer
5. *Stepless*, continuous balancing
6. Adaptable to narrow spans

FOXBORO
REG. U.S. PAT. OFF.
DYNALOG
ELECTRONIC INSTRUMENTS

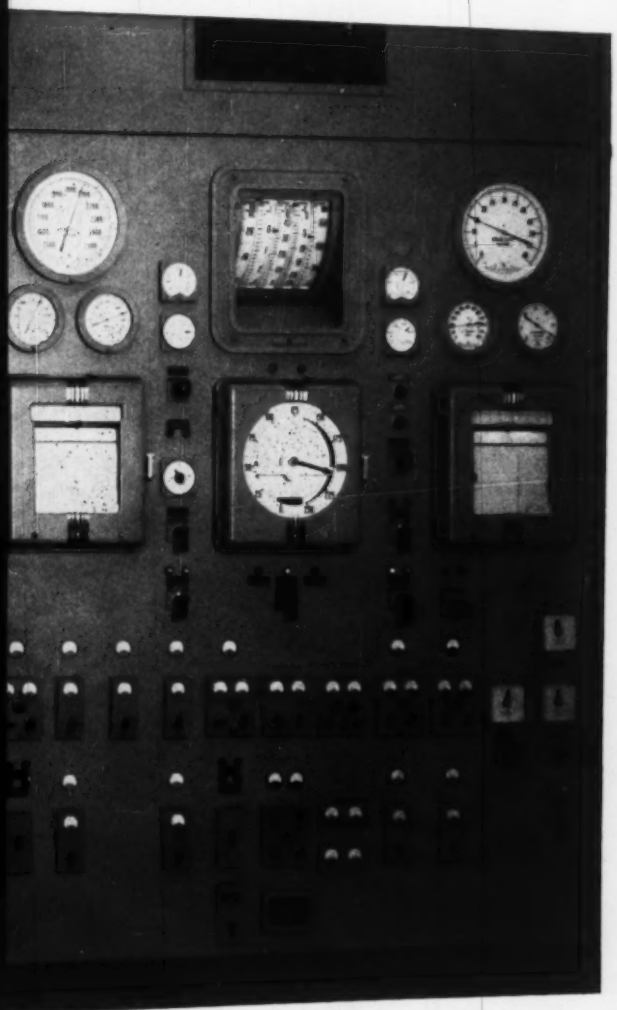
ANOTHER REPUBLIC ACHIEVEMENT!

Electronic Master Systems

. . . at Ohio Valley

Control Five 1,400,000 lb/hr. Boilers

Electric Corporation's Kyger Creek Power Plant



One of Kyger Creek's five Republic control centers. An Electronic Master operates to provide electric signals for pneumatic power positioners on 7 coal pulverizers, 2 F. D. fans and 2 I. D. fans on each boiler.

Five large boilers in this plant produce a million kilowatts for our nation's atomic energy program. Multiple components on each boiler must work simultaneously as a single unit, in order to operate at maximum efficiency under all loads. A Republic *load-sensing* combustion control system with an Electronic Master regulates all these inter-related functions . . . counters every fluctuation in steam flow with corrected fuel and air flow settings without waiting for variations in steam pressure. An integral *pressure* control system makes final corrections in control signals (if necessary) to hold steam pressure constant.

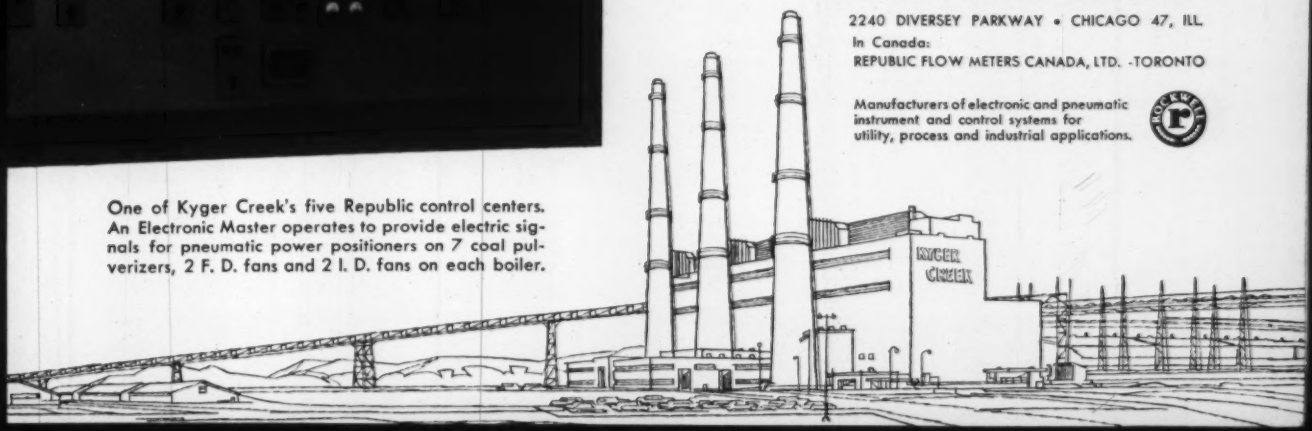
Republic's experience with plants of all sizes, all pressure and temperature ratings, and all load characteristics is your best guarantee of getting all the premium performance built into your major equipment. A technically-trained, thoroughly experienced Republic Sales Engineer is ready to discuss your instrument and control problems. Republic sales offices are located in principal cities throughout the country.

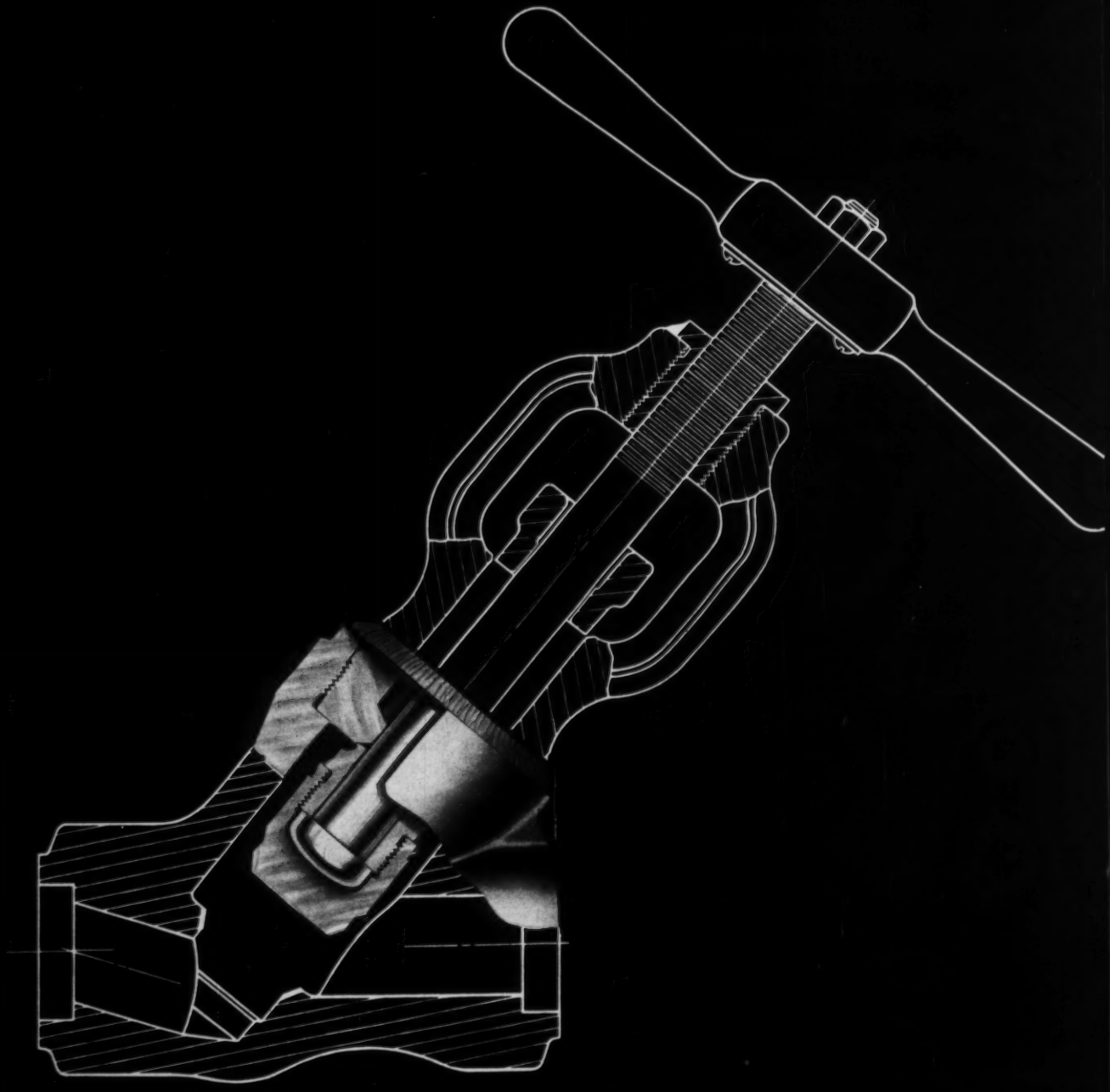
REPUBLIC
FLOW METERS CO.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

2240 DIVERSEY PARKWAY • CHICAGO 47, ILL.
In Canada:
REPUBLIC FLOW METERS CANADA, LTD. -TORONTO

Manufacturers of electronic and pneumatic instrument and control systems for utility, process and industrial applications.





EDWARD UNIVALVE

What's New from Edward Valves, Inc.

New Products . . . Problems and Solutions. . . Information on Steel Valves from Edward, Long-Time Leader in the Field!

Shoulder, thread and weld make

Superior "Univalve" Body-Bonnet Joint

Edward valve researchers were assigned three main goals in developing the Univalve* . . . first, design a globe valve for high pressure-temperature service—that would *stay* leak-proof . . . second, eliminate—as far as possible—the necessity for maintenance . . . third, fabricate all pressure-containing parts of forged steel for maximum strength and soundness.

How well they succeeded is illustrated by this fact: in many hundreds of advanced temperature-pressure applications all over the world, Edward Univalves have given consistently superior service. The *reason* for this is simple . . . Univalves, properly maintained, simply do not leak.

WELD SEALS JOINT

In the Univalve, a bead of fine-grained weld seals the body-bonnet joint to maintain perfect pressure tightness in any service. A guiding section above the threads protects them from the seal-weld; the threaded section and body shoulder carry the pressure load and insure accurate alignment. The rugged threaded bonnet—with opening just large enough to accommodate the stem—provides a pressure-tight backseat. The radiused disk nut contacts the beveled bonnet backseating surface . . . isolates packing from line pressures and temperatures . . . stretches packing life.

While the Univalve rarely needs attention, even its tough integral Stellite seating surface *can* become scored under some conditions. To strip for inspection and possible re-lapping, the seal-weld is easily removed by machining or grinding or with carbon arc or oxy-acetylene scarfing tip. Besides simple disassembly and positive backseat advantages, Univalve's one-piece gland eliminates possible small parts loss during repacking.

IDEAL FOR BLOW-OFF SERVICE. Univalves meet ASME Code for blow-off service and are adaptable for all high pressure installations.

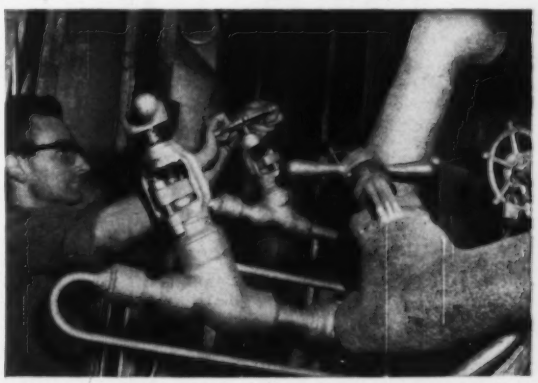
IMPORTANT UNIVALVE FEATURES:

Streamlined Flow Path reduces pressure drop, minimizes wear-producing turbulence. Univalve meets requirements for blow-off service.

Simple Packing Adjustment keeps packing maintenance down. Sturdy gland bolts, roomy yoke, one-piece forged gland.

Easy Open—Tight Close Operation of all Univalves 1¼" to 2½" made a reality with the exclusive Edward Impactor* handle.

Continuous Stellite Ring applied to body and disk, retains hardness under temperature and resists wear.



4500 LB UNIVALVE in service at Ohio Power Company's supercritical Philo station.

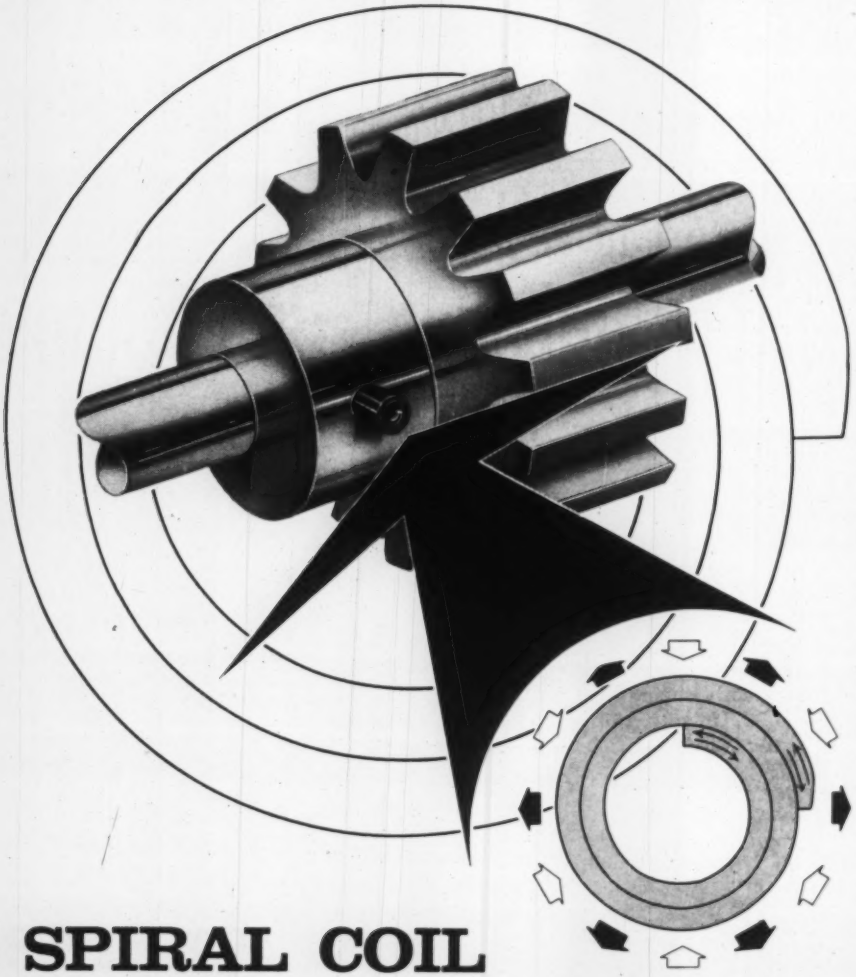
*T.M. Reg. U.S. Pat. Off.

EDWARD VALVES, INC.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

1228 West 145th Street, East Chicago, Indiana

Edward builds a complete line of forged and cast steel valves from ⅛" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs; for pressures up to 7500 lbs; with pressure-seal, bolted, union or welded bonnets; with screwed, welding or flanged ends.



THE SPIRAL COIL

makes SPIROL a true spring PIN

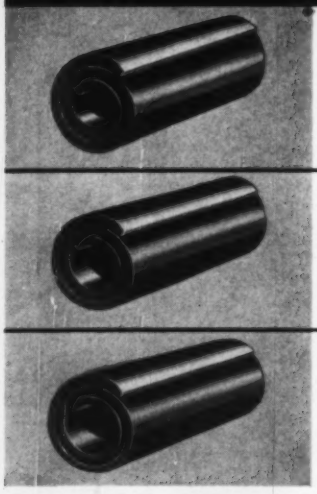
SPIROL PIN is a spirally coiled metal strip that acts like a true spring. When the pin is compressed into a hole, the radial tension is distributed *uniformly* throughout the spiral coils. There is no concentration of stress along a fragile "hinge line". This real coil-spring action permits wider plus-*and*-minus hole tolerances . . . eliminates precision reaming . . . works successfully with *low-cost* non-heat-treated metals. SPIROL's greater resilience increases shear strength, shock and vibration resistance.

FREE! *Write for literature on Spirol Pins.*

® SPIROL *the true spring* **PIN**

C. E. M. COMPANY • 95 SCHOOL ST. • DANIELSON, CONN.

SPIROL offers the widest range of flexibility, tension, and strength . . .



HEAVY DUTY

For applications where shear and shock loads are extremely severe, Spirol pin's spring action withstands high stress.

MEDIUM DUTY

Flexibility enables medium duty pins to absorb severe vibration. Have adequate shear strength for majority of applications.

LIGHT DUTY

Recommended for use in soft and brittle materials where the allowable bearing loads are low.

Burn COAL the MODERN WAY

with DETROIT STOKERS and SAVE!

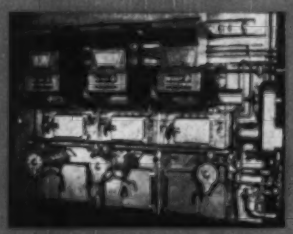
Coal is the economical fuel in most industrial areas. Safest to handle and store, its steady and continued supply is assured by huge reserves.

With a Detroit Stoker you can burn coal the modern way . . . saving 10% to 40% over other fuels.

Detroit Stokers are dependable, durable . . . last for decades. There is a type of Detroit Stoker to meet your needs.

Let us show you the savings available. Recommendations by our engineers will cost you nothing.

DETROIT ROTOSTOKER



Spreader stoker. Economically burns all grades of Bituminous coal or Lignite. Power, hand dumping or stationary grate types.

DETROIT LOSTOKER

Compact underfeed stoker for smaller boilers. Capacities 3,000 to 12,000 pounds steam per hour. Plunger feed, mechanically driven side cleaning. Coal feed and air supply may be automatically controlled.

DETROIT ROTOSTOKER—TYPE C-C

(Continuous Cleaning) Reciprocating grates that slowly discharge ash at front. Steaming capacities from approximately 5,000 to 75,000 pounds. Smokeless with wide load range.

DETROIT SINGLE RETORT STOKER

(Detroit UnderStoker)

Side cleaning, underfeed stokers. Motor or turbine driven. Adjustable feed provides manual and automatic control. Capacity range 12,000 to 24,000 pounds steam per hour.

DETROIT ROTOGRATE STOKER

Spreader stoker for higher capacities up to 400,000 pounds. Forward moving grates that discharge ash at the front. Higher burning rates for longer periods. Heavy duty.

DETROIT DOUBLE RETORT STOKER

Side cleaning heavy duty underfeed stoker with two retorts, mechanically driven. Available for capacities from approximately 20,000 to 34,000 pounds steam per hour. Requires no basement.

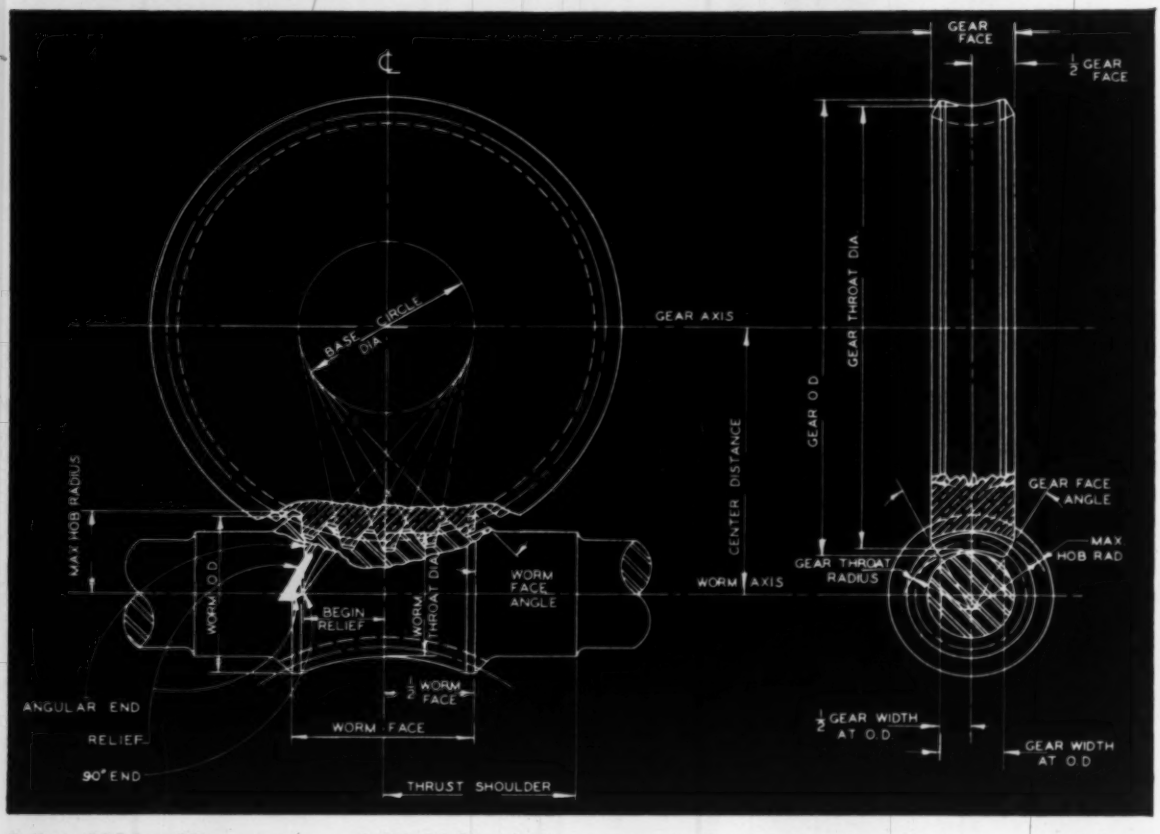
DETROIT STOKER COMPANY

MAIN OFFICE AND WORKS • MONROE, MICHIGAN

District Offices or Representatives in Principal Cities

DETROIT SINCE 1898 STOKERS

WORM GEAR DESIGN... *Bulletin #200*



Bulletin 200 has 20 pages crammed with 38 formulae, such as the Formula for Class I AGMA Horsepower Rating:

$$P = K_s K_m K_v \frac{n}{mg}$$

Step-by-step instructions, with typical examples, enable you to quickly determine the size worm gearset you need to meet any horsepower and service required.

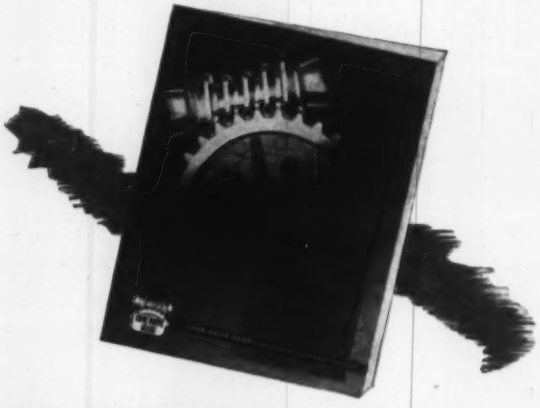
You can calculate the bearing loads and sizes needed for the worm and gear shafts.

You can check the worm root stress and gear tooth stress.

Efficiency is charted against helix angle with modifications for required speed so you can quickly determine efficiency.

One quick look at the drawing above will convince even the uninitiated that no other worm gearset has so many teeth in contact. No other worm gearset is so simple to design and rate. No other worm gearset will carry so much load in so little space with so little weight.

Now, Bulletin 200 provides complete design and application data on space-saving double-enveloping worm gearing. Ask for it without obligation.



CONE-DRIVE GEARS DIVISION MICHIGAN TOOL COMPANY

7171 E. McNichols Road • Detroit 12, Michigan • Telephone: TWinbrook 1-3111

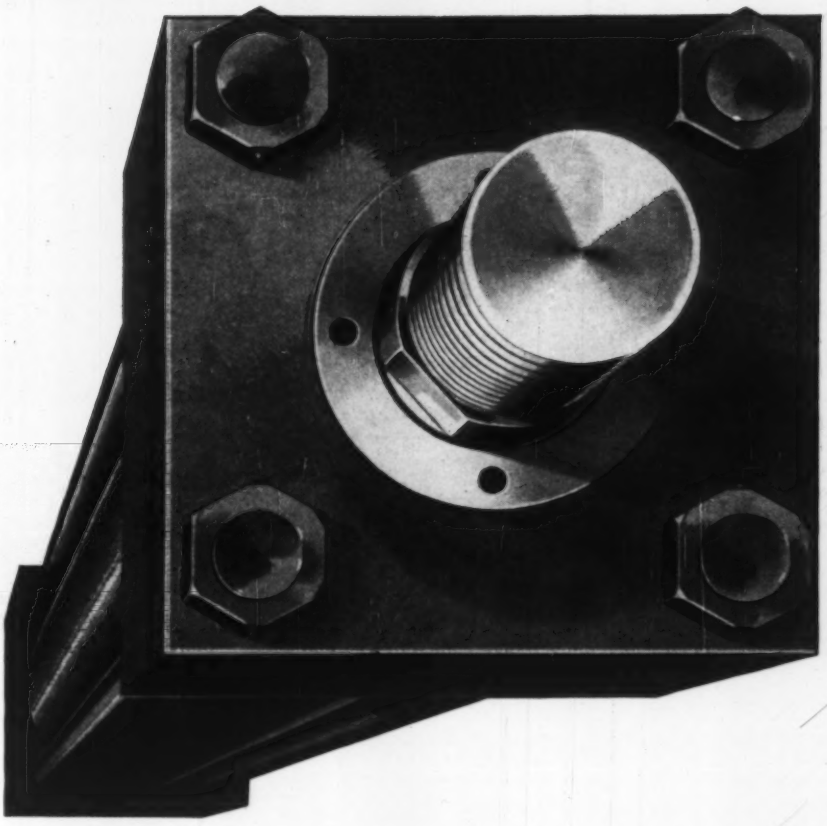
DOUBLE-ENVELOPING WORM GEARSETS

DOUBLE-ENVELOPING WORM GEAR SPEED REDUCERS

DOUBLE REDUCTION WORM GEAR SPEED REDUCERS

DOUBLE-ENVELOPING RIGHT ANGLE GEARMOTORS

AT YOUR REQUEST...



ANKER-HOLTH

Hydraulic Cylinders now available in Square Head design

Positive Trouble-free Performance

Anker-Holth Division, for 18 years designers and manufacturers of quality air and hydraulic power cylinders, now offers a standard line of all steel, high pressure square head tie rod cylinders. Important new operating features and design achievements assure positive controlled power for a wide range of industrial applications.

Standardized Mountings for Interchangeability

Conservatively rated at 2000 P. S. I. working pressure and 3000 P. S. I. non-shock pressure every cylinder is proof tested at 4500 P. S. I. All mountings are available, standard bores from 1½ to 8 inches. Standardized mountings provide complete interchangeability with most makes of square head cylinders. The Anker-Holth "□" line meets all J. I. C. specifications.

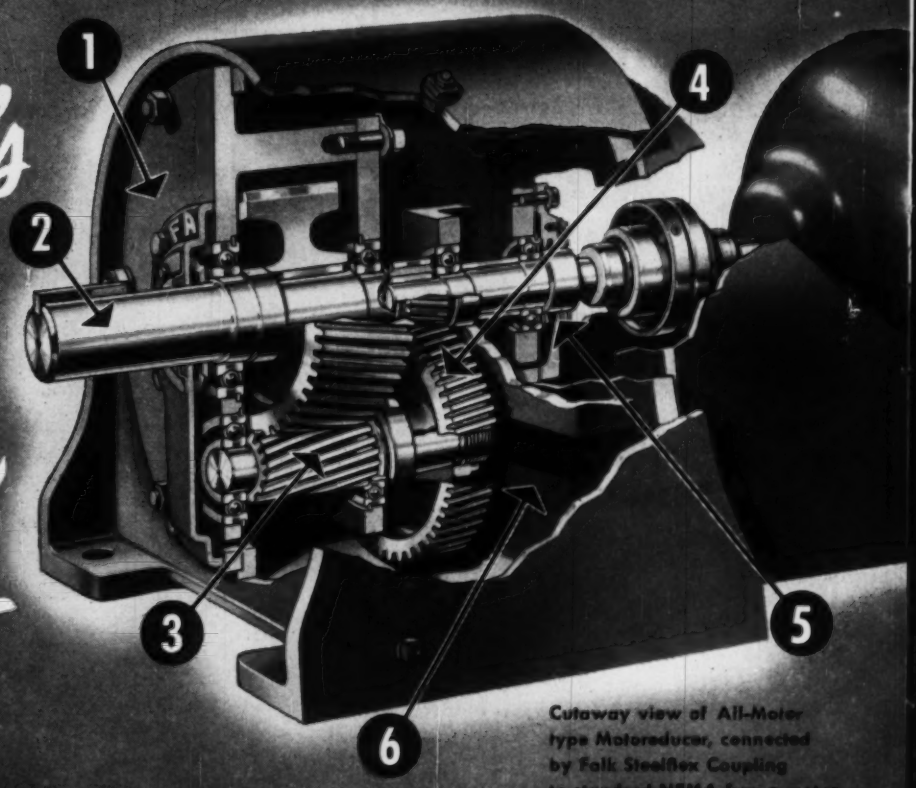
For more information contact your local Anker-Holth representative or Anker-Holth Division, Port Huron, Michigan. YUkon 5-7181

ANKER-HOLTH DIVISION

THE WELLMAN ENGINEERING COMPANY

2727 CONNOR STREET, PORT HURON, MICH., U. S. A.

Here's the inside story—



Cutaway view of All-Motor type Motoreducer, connected by Falk Steelflex Coupling to standard NEMA frame motor

WHY Falk Motoreducers give better service—have longer life

Here is the "inside story" behind the all-steel All-Motor type FALK Motoreducer's universal reputation as a gear drive unmatched in quality, efficiency, dependability, ease of maintenance and long life. These "In-built" factors are—

1 **ALL-STEEL HOUSINGS.** Rugged, strong, rigid...all parts are manufactured from heavy steel plate, formed and welded in the Falk Weld Shop.

2 **LARGE OVERHUNG LOAD CAPACITY.** Large shafts, oversize bearings...rigid mountings with wide bearing spans to handle maximum applied loads.

3 **PRECISION GEARING.** Heat-treated alloy steel gearing, precision cut and shaved after heat treatment to eliminate distortion. Quiet, crown-shaved pinions.

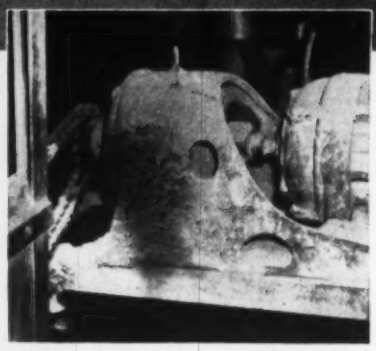
4 **EXTRA-CAPACITY GEARING.** Special extra-capacity gear-tooth form with larger contact area gives greater strength, higher load-carrying capacity.

5 **SEALED HOUSINGS.** Splashproof, dustproof, oil-tight construction. Dual closures and one-way vents keep oil in, dust and moisture out.

6 **POSITIVE LUBRICATION.** Large sump capacity...oiltight construction assures clean lubricant...revolving elements lubricated by direct dip.

When you buy or specify the All-Motor type FALK Motoreducer, you get all these—plus the tremendous advantage of full interchangeability of motors. Switch motors as desired—use any make, style or type of standard foot-mounted motor within the unit's AGMA rating—with a minimum of difficulty or "down time."

Available in sizes up to 75 hp—*with or without motor*—from convenient factory, field or distributor stocks, from coast to coast. **Write for Bulletin 3100.**



60,000 HOURS WITHOUT A FAILURE!

Sixty thousand hours is a lot of hours—but the FALK Motoreducer in the unretouched photo above has served that long without failure or need of repair.

This 3 hp unit is one of over 60 FALK Motoreducers in daily service in an Eastern plant of a large milling company, whose president says, in part:

"One of the main advantages of FALK Motoreducers is their adaptability to any motor. Reducers and motors can be easily interchanged....Our service records confirm the wisdom of our choice of FALK equipment as our standard."

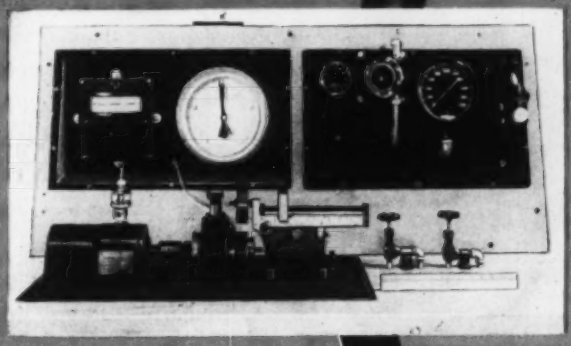
FALK ...a good name in industry

THE FALK CORPORATION, MILWAUKEE, WISCONSIN

MANUFACTURERS OF

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
- Steel Castings
- Weldments
- Contract Machining

Low Cost Rotary Seals



Precision test stand especially developed to test efficiency of "O" rings as low cost rotating shaft seals.

Precision "O" Rings from Compound 158-80 provide the answer to a problem for a manufacturer of Oil-Hydraulic Pumps.

1. Eliminated costly hand lapping
2. Reduced friction—increased life
3. Sealed 2000 P.S.I.

Compound 158-80, with built in lubrication, is especially suitable for those jobs where friction is a problem. They are compression molded, rigidly inspected —the finest made!

Have a sealing problem? You'll find the answer at Precision! There's a Precision engineer ready to help you in "O" Ring specification and product design.

Get your free copy of our Engineering Data Sheet on Compound 158-80.

Specify Precision—first in quality

Precision Rubber Products Corporation

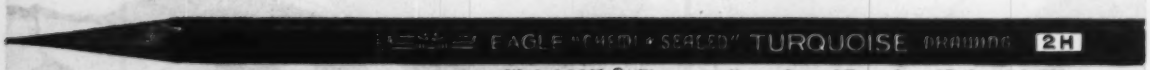
"O" Ring and Dyna-seal Specialists

Dept. 9, Oakridge Drive, Dayton 7, Ohio

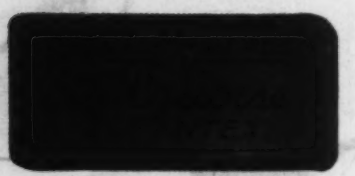
Canadian plant at: Ste. Thèrése de Blainville, Québec

do your **drawings** do justice to your **designs?**

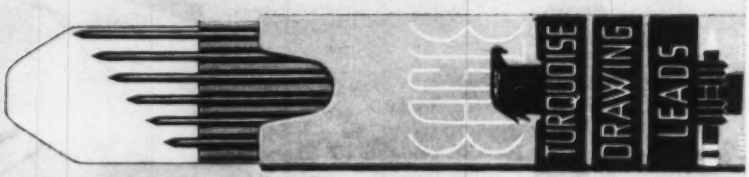
It takes a sharp drawing to sell a sharp idea —and you're halfway there when you pick up an EAGLE TURQUOISE drawing pencil. *No pencil on the market can match TURQUOISE for reproduction!* For one thing, TURQUOISE is tops for uniform grading. 17 scientific formulas guarantee exactly the blackness you want—from every pencil, every time! You get a strong needle point that just won't crumble—and stays sharp for line after long line of unchanging width. You can't beat it for smoothness, either—thanks to Eagle's exclusive ®"Electronic" graphite. TURQUOISE makes your drawings look sharp—and *you, too!*



• **TURQUOISE DRAWING PENCILS:** With 100% ®"Electronic" graphite. 17 grades, 6B through 9H.



• **TURQUOISE CLEANTEX ERASER:** Super-soft, non-abrasive rubber.



• **TURQUOISE DRAWING LEADS:** Fit any standard holder. Grades 5B through 9H.

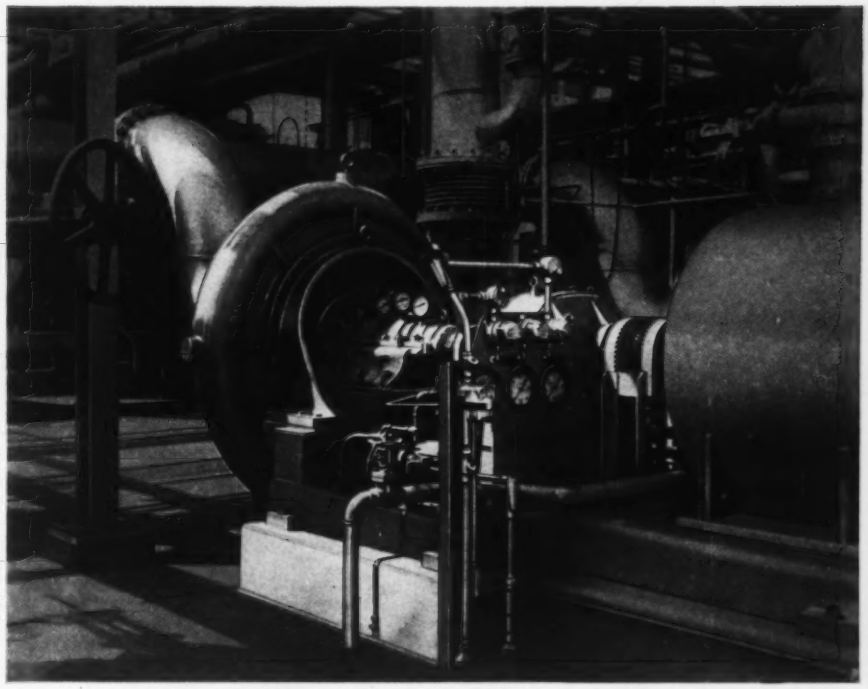
• **TURQUOISE LEAD HOLDERS:** Hold any grade of Turquoise lead—so firmly that lead cannot be pressed back.

EAGLE ®TURQUOISE PENCILS, LEADS AND HOLDERS

are the largest-selling in the United States!

EAGLE PENCIL COMPANY • NEW YORK • LONDON • TORONTO • MEXICO • SYDNEY • BOGOTA

FOR TIDEWATER OIL COMPANY'S GREAT NEW REFINERY



Process Design
—Ralph M. Parsons Co.

Constructors
—C. F. Braun & Co.

R-C
Centrifugal Equipment
purchased for
this installation

Three single-stage centrifugal blowers, two turbine driven and one motor driven. Each blower is rated at 11,500 cfm at 4.8 psig operating at 5100 RPM requiring approx. 320 HP

R-C Centrifugal Blowers Supply Combustion Air for Sulfur Plant

For the industry's largest sulfur-recovery plant at Tidewater's "refinery of the future" at Delaware City, Roots-Connersville centrifugal blowers supply combustion air for processing hydrogen sulfide from sour crudes to elemental sulfur.

One of the basic design requirements for this plant is extreme flexibility. When the refinery is operating on high-sulfur crudes, sulfur production may reach 340 long tons per day. With low-sulfur crudes, production may be less than one-fifth this amount.

To satisfy these widely varying requirements, Roots-Connersville centrifugal blowers assure positive control of air delivered to the reaction furnaces. Whatever the conditions may be, they provide the kind of dependability that results in continuous, efficient operation for long periods of time. Whatever the service, you can count on this dependability in Roots-Connersville centrifugal equipment in capacities from 1,100 to over 100,000 cfm.

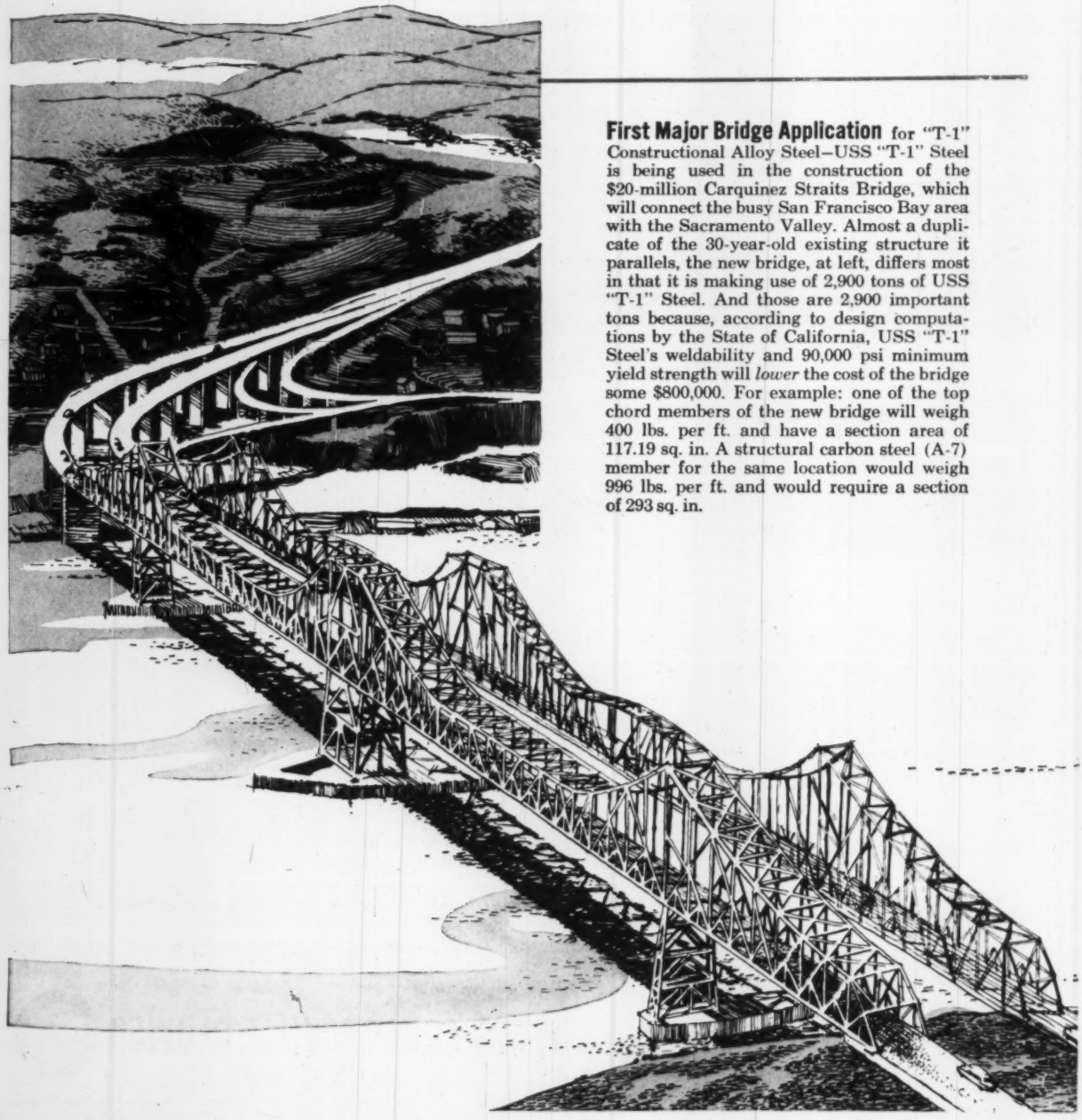
For additional data, please refer to our section in **Chemical Engineering Catalog** or **Mechanical Catalog** or write for Bulletin 120-B-14.

ROOTS-CONNERSVILLE BLOWER

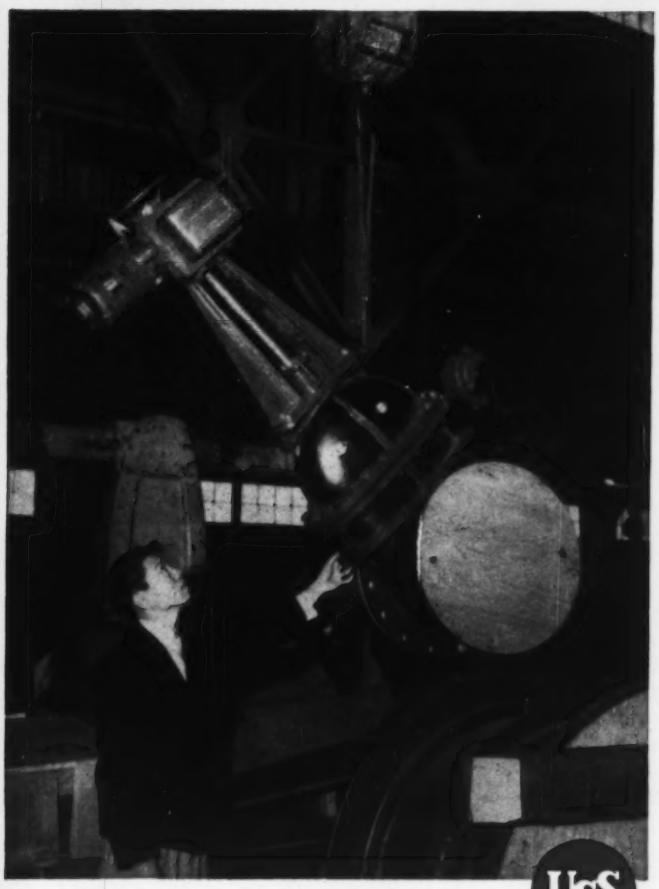
A DIVISION OF DRESSER INDUSTRIES, INC.

258 Michigan Avenue, Connersville, Indiana. In Canada—629 Adelaide St., W., Toronto, Ont.

HOW USS "T-1" STEEL IMPROVES THESE PRODUCTS:



First Major Bridge Application for "T-1" Constructional Alloy Steel—USS "T-1" Steel is being used in the construction of the $20-million Carquinez Straits Bridge, which will connect the busy San Francisco Bay area with the Sacramento Valley. Almost a duplicate of the 30-year-old existing structure it parallels, the new bridge, at left, differs most in that it is making use of 2,900 tons of USS "T-1" Steel. And those are 2,900 important tons because, according to design computations by the State of California, USS "T-1" Steel's weldability and 90,000 psi minimum yield strength will *lower* the cost of the bridge some $800,000. For example: one of the top chord members of the new bridge will weigh 400 lbs. per ft. and have a section area of 117.19 sq. in. A structural carbon steel (A-7) member for the same location would weigh 996 lbs. per ft. and would require a section of 293 sq. in.



At Home In A Crowd. That's USS "T-1" Steel. It's really at home in this, the crowd rack of the world's largest power shovel. Built by Marion Power Shovel Company, the big digger is in service for Hanna Coal Company. Operating around the clock, winter included, the crowd rack must withstand constant, brutal impact loading, often in sub-freezing temperatures. USS "T-1" Steel (also used in the dipper, dipper stick and bail) supplies the strength, toughness, and resistance to impact abuse so critically needed.

Fabri-Valve Fabricates Faster For Less. The Fabri-Valve Company of America fabricates valves as opposed to casting them. A recent job for the U.S. Air Force called for 2 types of electric-motor-operated wedge-gate valves, subject to temperatures from well below zero up to 300° F., and pressures of 37.5 psi absolute plus a shock load of 200 psig. By using USS "T-1" Steel for the majority of the valve parts, Fabri-Valve pared off 25% of the time and expense normally required to fabricate the valves. Quoting the Company's Vice President, "USS 'T-1' Steel was chosen for its toughness, impact strength, its quality of handling low temperature applications. Very important, too, is its ready weldability and fabricability. USS 'T-1' Steel's yield strength of 90,000 psi helped reduce thickness, thereby reducing cost."

HOW IT CAN HELP YOU

USS "T-1" Steel, with its high minimum yield strength of 90,000 psi and its minimum tensile strength of 105,000 psi, can help you design or build lighter-weight equipment that will last longer. Its unusual toughness can help you design or build equipment capable of taking severe impact and abuse at sub-zero temperatures. Its weldability can help you cut the cost of fabricating highly stressed parts, and reduce repair and maintenance expense. Its good creep rupture strength can help you put more durability in equipment that operates at temperatures as high as 900 degrees F.

Somewhere in your operation, versatile USS "T-1" Steel can help you. Write, wire, or phone United States Steel, Pittsburgh 30, Pa.

USS "T-1" CONSTRUCTIONAL ALLOY STEEL

"USS" and "T-1" are registered trademarks

United States Steel Corporation, Pittsburgh • Columbia-Geneva Steel Division, San Francisco • Tennessee Coal & Iron Division, Fairfield, Ala.
United States Steel Supply Division, Warehouse Distributors, Coast-to-Coast • United States Steel Export Company, New York

UNITED STATES STEEL

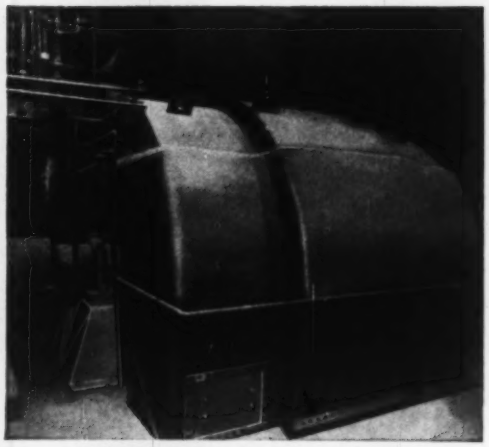
World's largest open hearth furnace utilizes Clarage Fans

600 TONS— enough steel in each heat for 300 automobiles. That's the capacity of Weirton Steel Company's new open hearth furnace at Weirton, W. Va. Weirton Steel is a division of National Steel Corporation.

Designed and built by Loftus Engineering Corporation, Gateway Center, Pittsburgh, this giant is completely automatic in operation.

As for so many other impressive installations, Clarage equipment was selected — a Clarage induced draft fan for the waste heat boiler and a Clarage forced draft fan for the furnace.

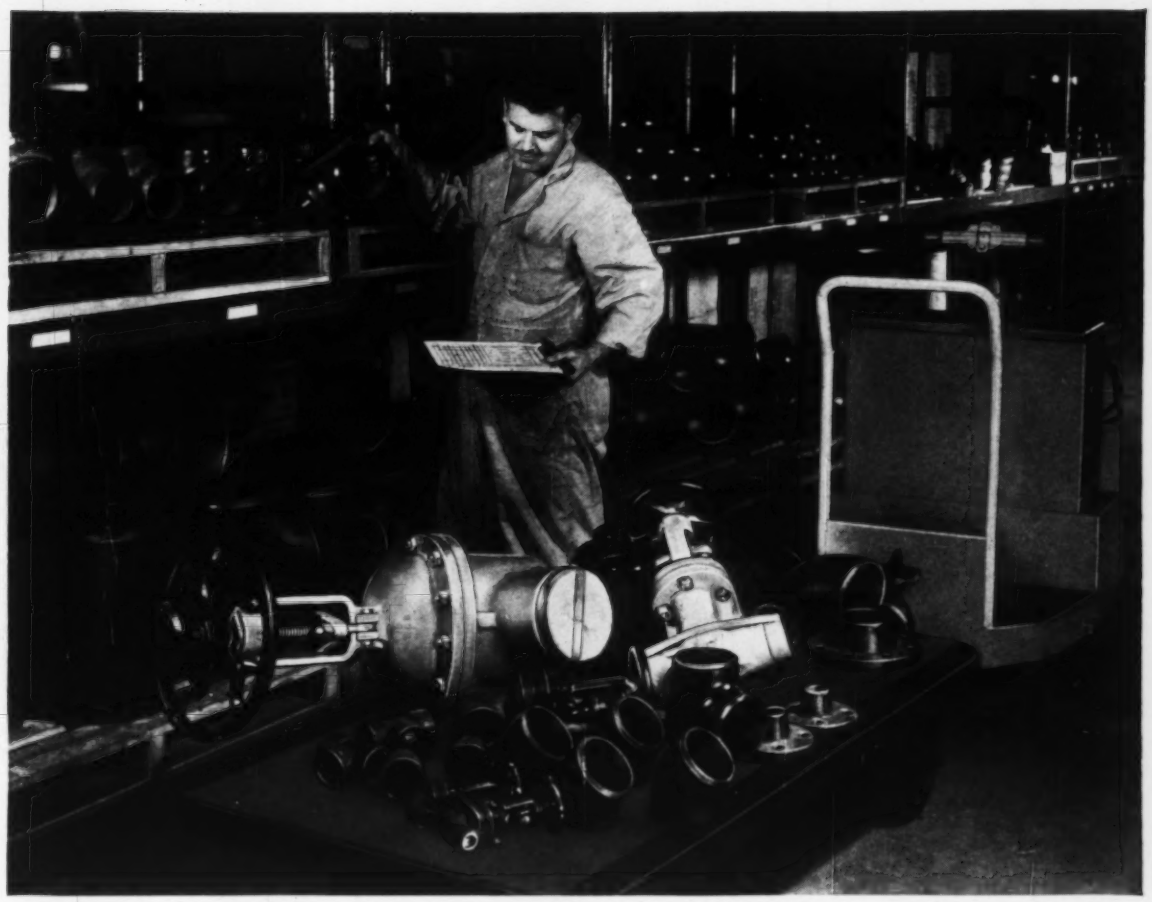
Investigate the advantages Clarage equipment offers for YOUR mechanical draft installations. Contact our nearest sales engineering office or write us for complete literature. CLARAGE FAN COMPANY, Kalamazoo, Michigan.



Clarage heavy-duty fan provides induced draft for waste heat boiler.

CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal



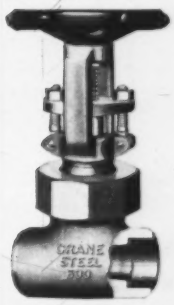
When specifications say "Welded Piping" get everything for the job from CRANE

It is far more satisfactory to get *all* your welding piping materials . . . fittings, flanges, valves, nipples, pipe... from *one* source—CRANE.

Then you're sure of uniform quality. Whether the product is a simple fitting or 24-inch high-pressure, high-temperature valves, Crane controls quality—from raw materials to the finished product.

Each welding type fitting, flange or valve you get from Crane is produced and inspected to established standards—assuring uniform size, wall thickness, and dimensional accuracy—for a good welding job.

One source of supply—from Crane—simplifies ordering, bookkeeping and stock-keeping. Prompt delivery service can be had from Crane's 141 branches, or from wholesalers who serve all areas.



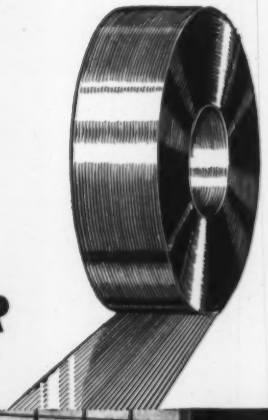
Send for this new Circular of Crane Quality Materials for Welded Piping. Ask for AD-2289.

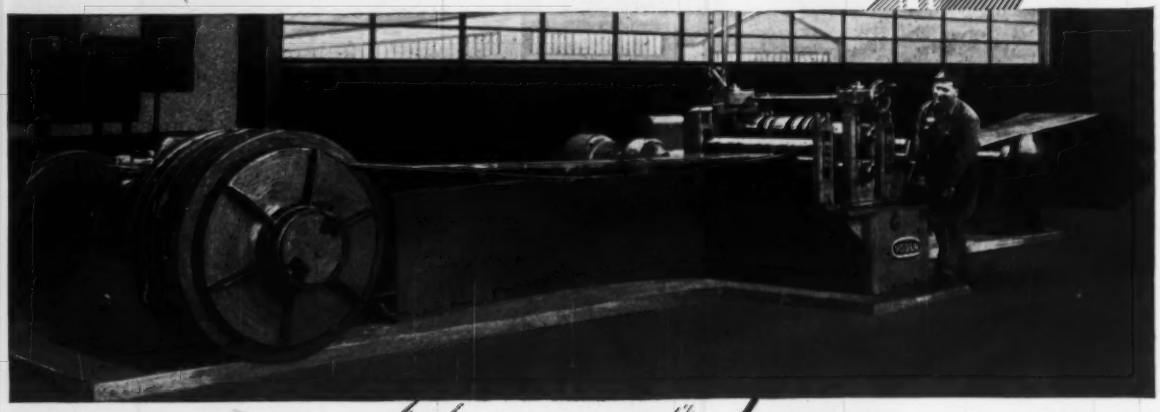
CRANE VALVES & FITTINGS

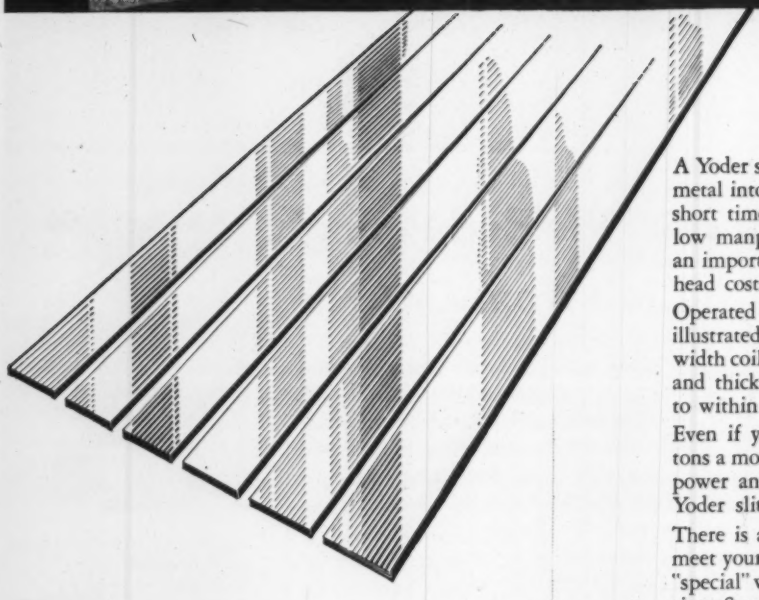
PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

from cold strip to slit strands
IN SECONDS...
with a YODER
ROTARY MULTIPLE SLITTER







A Yoder slitter converts mill-width coils of flat-rolled metal into many variable-width strands in amazingly short time. Speed, coupled with great accuracy and low manpower requirements, makes a Yoder slitter an important factor in keeping production and overhead costs down.

Operated by only two men, the Yoder Type 3-48 slitter illustrated is designed to accommodate standard mill-width coils up to 48 inches wide, in a variety of metals and thicknesses. The slit strand widths can be held to within a .004" tolerance.

Even if your steel requirements are as little as 100 tons a month, the savings to be realized in time, manpower and raw material costs alone will pay for a Yoder slitter in the first few months of operation.

There is a Yoder slitter designed and engineered to meet your requirements, and to speed the delivery of "special" width stock in a wide range of large or small sizes. Send for your free copy of the fully-illustrated, 76-page booklet, "Multiple Rotary Slitting Lines."

THE YODER COMPANY
5499 Walworth Avenue • Cleveland 2, Ohio

ENGINEERING **YODER** MANUFACTURING

ROTARY SLITTING LINES
PIPE AND TUBE MILLS (ferrous or non-ferrous)
COLD ROLL FORMING MACHINES

Is your tubing bottleneck shown here?

Bundy Engineers and versatile Bundyweld Tubing can beat the knottiest tubing design problem!

If you think it can't be done with tubing, it's a challenge to Bundy. For years, Bundy Engineers have specialized in working with customers and prospects, solving the insolvable. A unique combination of imagination and experience, plus the extreme versatility of Bundyweld Steel Tubing, has paid off again and again.

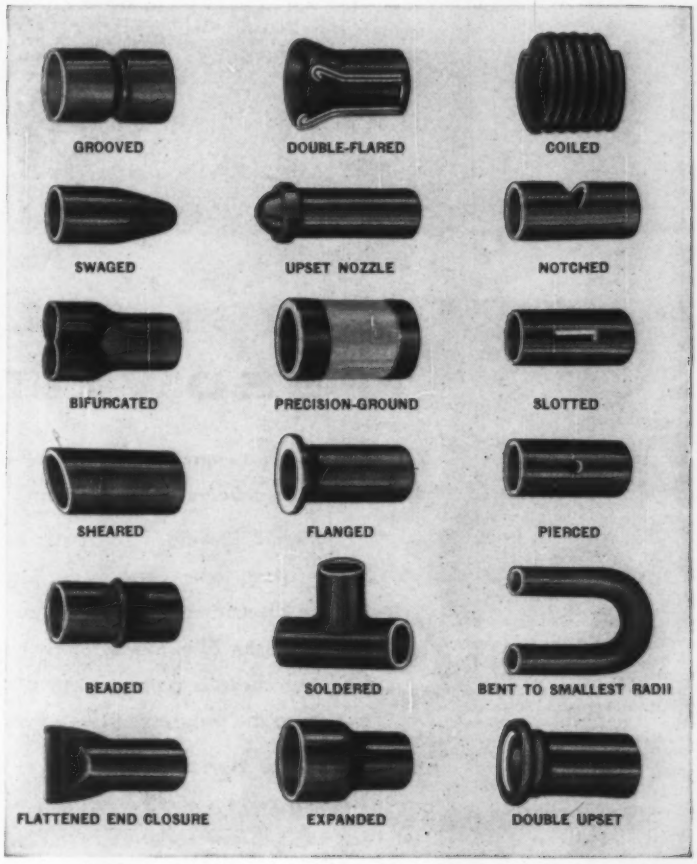
Check first with Bundy for workable solutions to your tubing design problems. Whether you are in the design, developmental, or application stage of your product, Bundy will be glad to work with you. Hundreds of manufacturers have used this Bundy service to advantage.

Bundyweld Tubing offers an unusual combination of properties: high thermal conductivity; high bursting strength; ease of fabrication; and thinner-walled, yet stronger composition. It is the safety standard of the refrigeration industry, and is used in 95% of today's cars, in an average of 20 applications each.

Call, write, or wire us today!

BUNDY TUBING COMPANY

DETROIT 14, MICHIGAN



Shown above are but a few of the fabrication operations which are possible with Bundyweld Steel Tubing. Many of these, and others not shown, were developed through solving a specific problem brought to us by a customer or prospect. Bundy invites you to avail yourself of this design service.

WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING. AFFILIATED PLANTS IN AUSTRALIA, ENGLAND, FRANCE, ITALY, AND GERMANY

Bundyweld starts as a single strip of copper-coated steel. Then it's

. . . continuously rolled twice around laterally into a tube of uniform thickness and passed

through a furnace. Copper coating fuses with steel. Result . . .

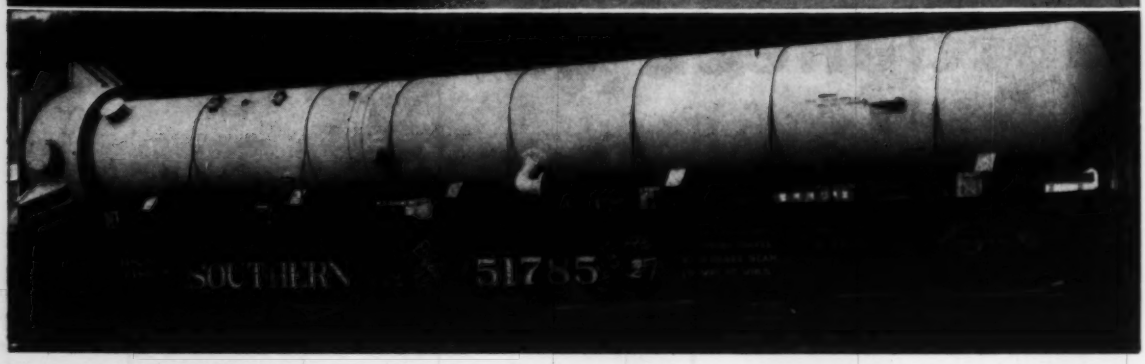
Bundyweld, double-walled and brazed through 360° of wall contact.

NOTE the exclusive Bundy-developed beveled edges, which afford a smoother joint, absence of bead, and less chance for any leakage.

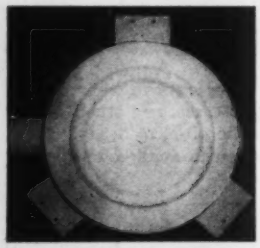
BUNDYWELD TUBING®

DOUBLE-WALLED FROM A SINGLE STRIP

PROGRESS IN POWER through PROGRESS IN HEAT TRANSFER EQUIPMENT



Workman welding copper-nickel tubes to foot-thick steel tube sheet with 140-monel electrodes. Under destructive testing, rolled joints and tubes welded with cupro nickel rods leaked at elevated pressures, but tubes welded with 140-monel electrodes were leak-proof at 9600 psi



End view showing torus ring welded to channel and channel cover. Access to head is obtained by cutting ring with special tool; torus ring can be re-used. Conventional split key ring assembly taking the load on the cover is retained

FIRST ALL-WELDED FEEDWATER HEATERS

▶ A few years ago, an all-welded feedwater heater for 3600 psi and 790F would have been called a fantastic dream.

Yet six all-welded feedwater heaters in this pressure-temperature range are now proving their worth in the Linden, N. J., Generating Station of the Public Service Electric and Gas Company. Designed and manufactured by the Yuba Heat Transfer Division, formerly the Heat Exchanger Division of The Lummus Co., these heaters represent one of the many "firsts" contributed by this organization to the progress of the power industry.

In the heater shown above, two 50-inch-diameter cylinder sections of 1⅛-inch carbon steel were welded together. The open ends of the U-bends are welded, not roller-expanded, into the tube sheet (see upper small photo). Heads are sealed by a steel torus ring welded to channel cover and channel (see lower small photo).

The all-welded design minimizes the leakage which occurs in the conventional bolted and gasketed construction under high temperatures and pressures. Results are reduced maintenance and downtime.

This all-welded construction has been so successful it is certain to be specified for practically all future installations. Yuba engineers would be pleased to work with you. Call on them.

YUBA

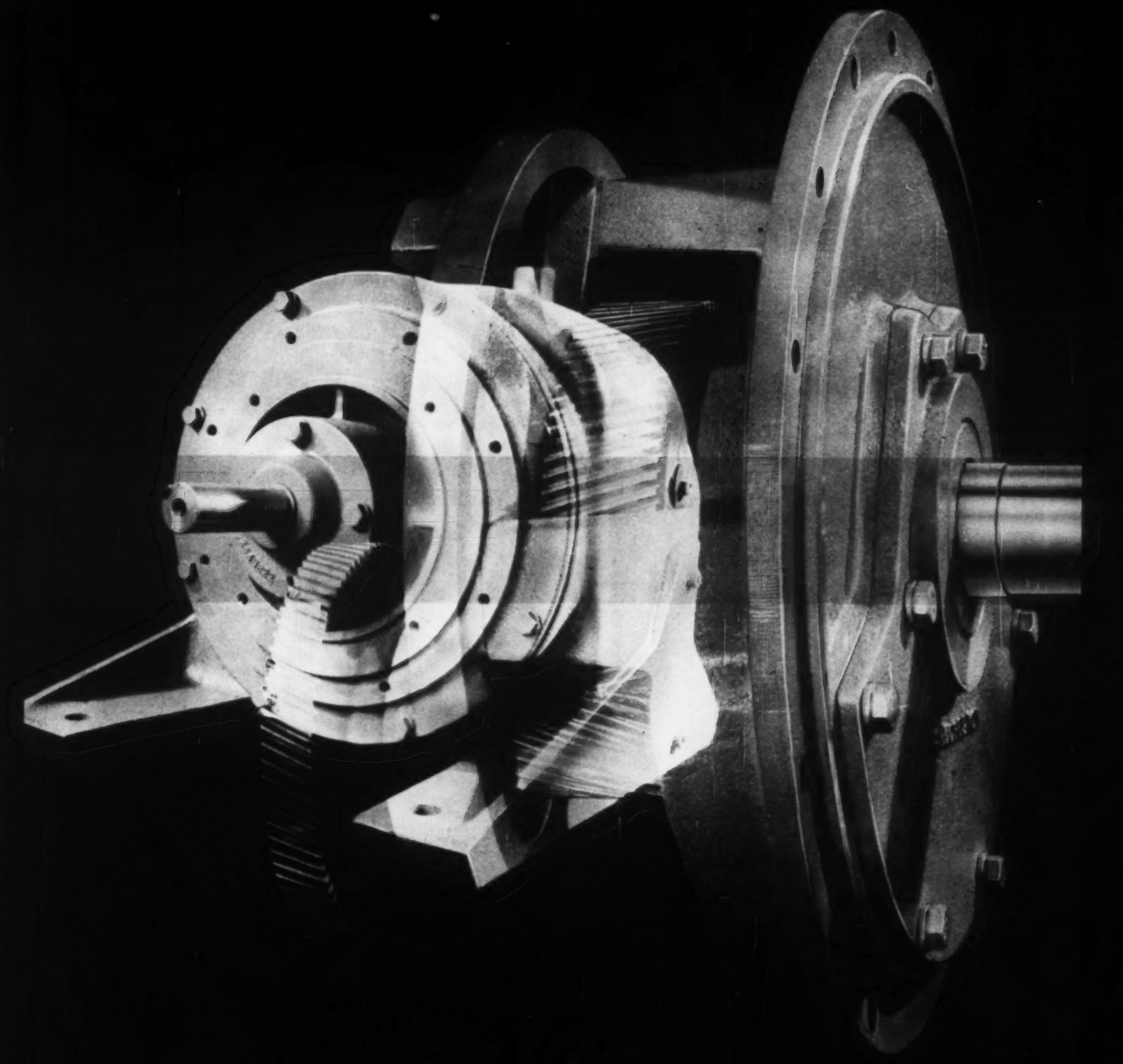
CONSOLIDATED INDUSTRIES, INC.

Other Divisions Manufacturing Heat Transfer Equipment
California Steel Products Division, Richmond, Cal.
Adsco Division, Buffalo, N. Y.

YUBA HEAT TRANSFER DIVISION
HONESDALE, PENNSYLVANIA
NEW YORK SALES OFFICE: 530 FIFTH AVENUE
REPRESENTATIVES IN PRINCIPAL CITIES

STEAM SURFACE CONDENSERS · EVAPORATORS
STEAM JET REFRIGERATION · STEAM JET AIR EJECTORS
FEEDWATER HEATERS · BAROMETRIC CONDENSERS

EXCLUSIVE DEVELOPMENT OF WESTINGHOUSE ELECTRIC CORPORATION

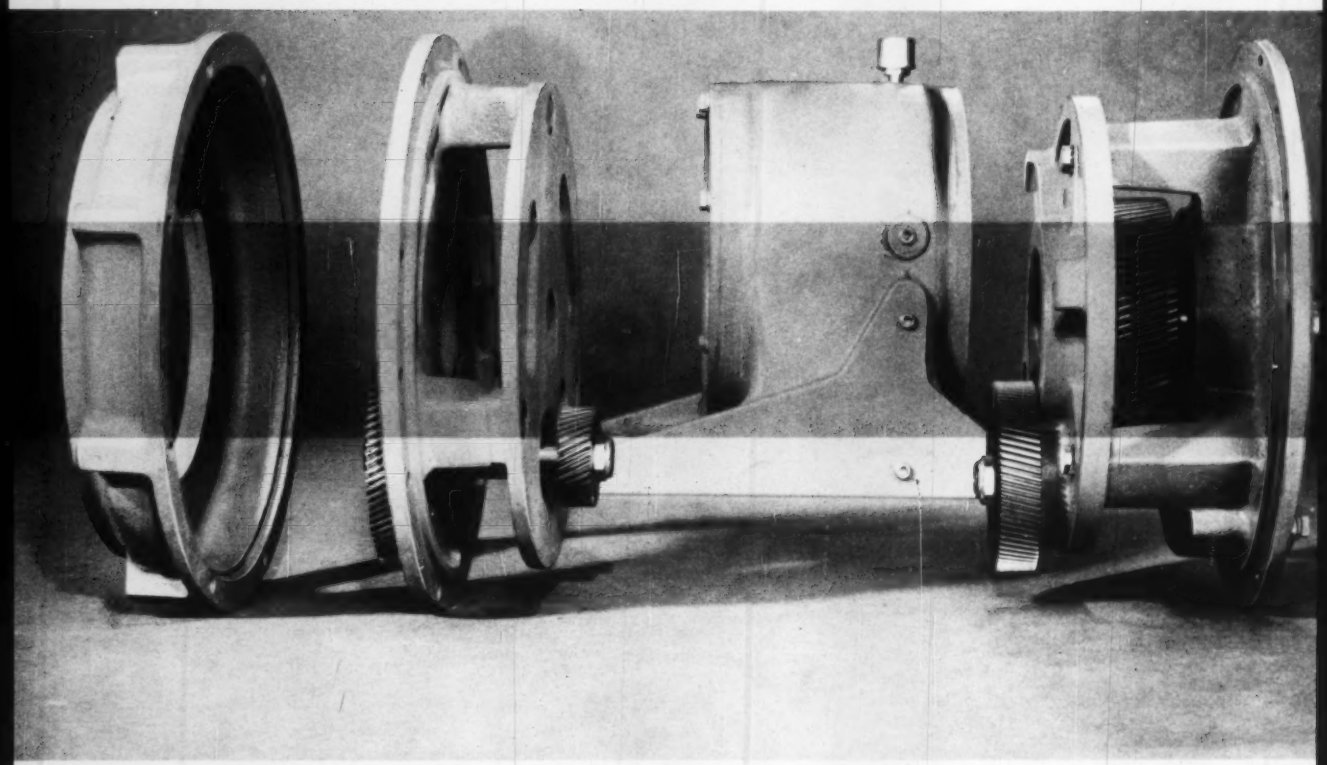


NEW MODULINE GEAR UNITS

OFFER YOU ORIGINAL ADVANTAGES IN
SIMPLICITY • VERSATILITY • DEPENDABILITY

MODULINE

IS ORIGINAL IN SIMPLICITY...IN VERSATILITY



Basic Moduline components combine to form double, triple or quadruple reduction speed reducers, gearmotors or package motor reducer drives with gear ratios from 4.17:1 to 985.3:1.

These preassembled modules standardize over 20,000 variations of gearmotors, speed reducers and package motor reducer drives

Look over the simplicity, dependability and versatility you get from Westinghouse Moduline gear units. Here you'll find original answers to solve long-standing problems in application of gearmotors and package motor reducer drives from 1 to 30 hp; foot-mounted speed reducers from 1 to 75 hp; and shaft-mounted speed reducers from 1 to 40 hp, including concentric shaft and right angle configurations.

What's more, just seven Moduline frame sizes cover these broad ranges. By ordering Moduline drives, together with any type of Westinghouse Life-Line® motors, you combine two purchases in one order with complete assurance of design and application coordination.

JI-07368-2

EXCLUSIVE DEVELOPMENT OF

MODULINE

delivery is fast because it's "built in"

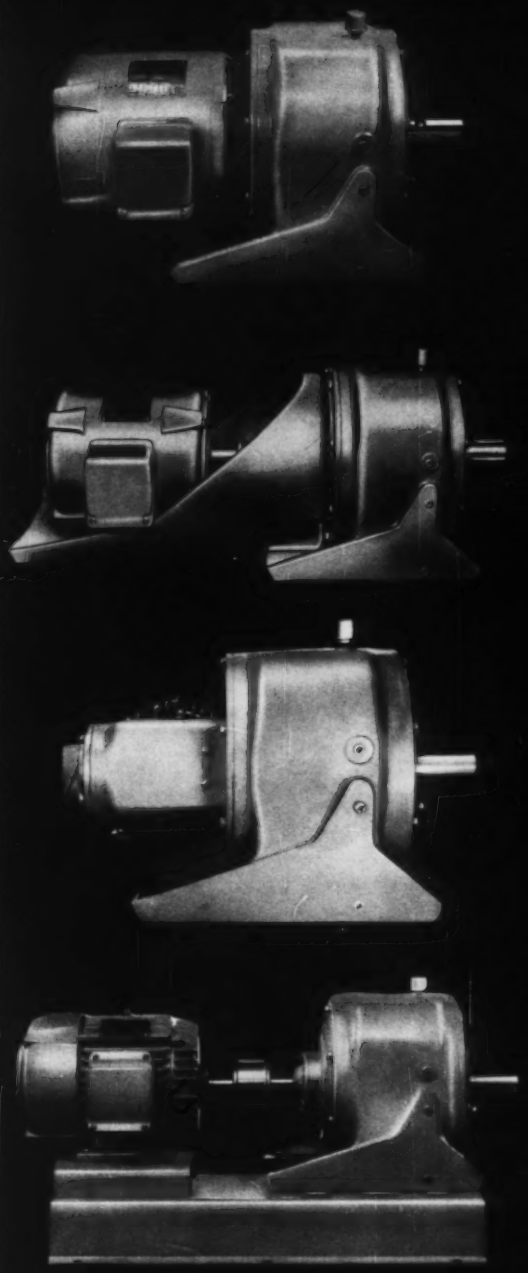
Original modular design and complete standardization of components simplifies specification, inventory control and gives fast deliveries from local Westinghouse warehouses.

Your local Westinghouse sales office fills your order from a nearby warehouse. Moduline drives are shipped completely assembled to your instructions, ready to go to work. All Moduline warehouses also carry complete stocks of renewal parts and subassemblies for the maintenance or modification of customer units. Fast parts deliveries and serviceability of Moduline designs reduce down time and maintenance costs to a minimum. A small inventory backs up many units for customers who prefer to stock their own parts and subassemblies.

...see MODULINE facts in action

A desk-top demonstration of Moduline scale models is the first step to lower gear drive costs. Your Westinghouse sales representative will arrange a demonstration; or write Westinghouse Electric Corporation, Gearing Division, 200 McCandless Ave., Pittsburgh 1, Pa.

JI-07368-6

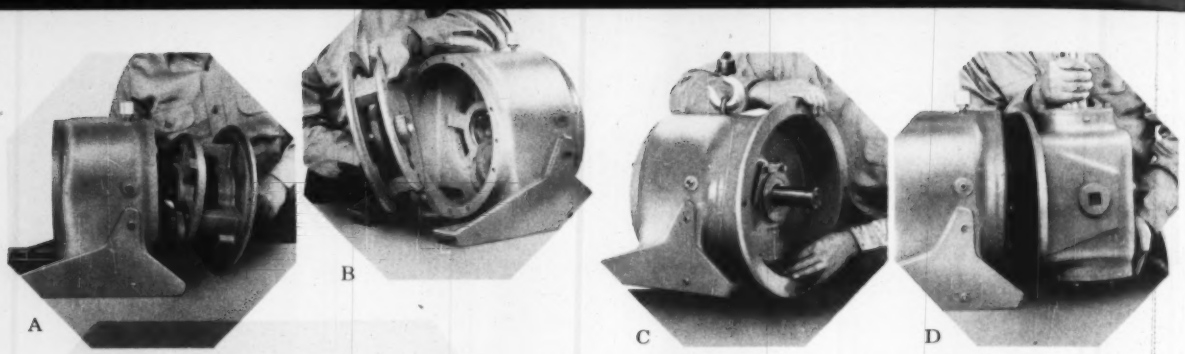


POWER-UP with MODULINE

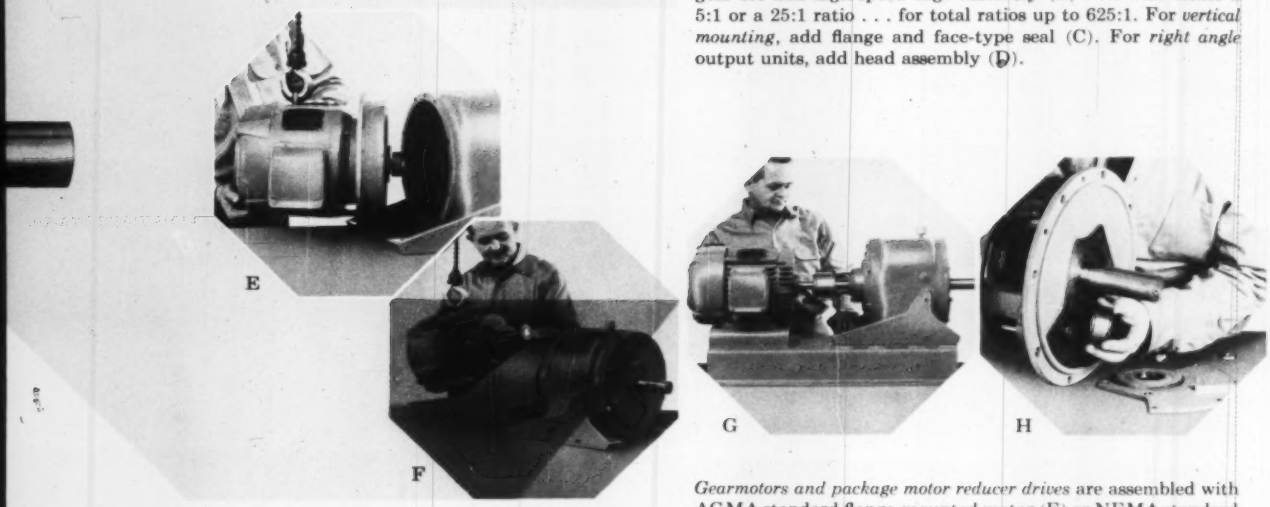
a complete line of . . .
speed reducers . . . gearmotors . . .
and motor reducer drives

YOU CAN BE SURE... IF IT'S

Westinghouse



For *speed reducer* assemblies (above), reducer case and low-speed cage assembly with 5:1 gear ratio combine with high-speed change pinion and gear set (A) which are available in nine standard ratios from 1:1 to 5:1 and for double reductions up to 25:1. For triple and quadruple reductions, add change gear set and high-speed cage assembly (B) . . . with either a 5:1 or a 25:1 ratio . . . for total ratios up to 625:1. For *vertical mounting*, add flange and face-type seal (C). For *right angle* output units, add head assembly (D).



Gearmotors and package motor reducer drives are assembled with AGMA standard flange-mounted motor (E) or NEMA standard foot-mounted motor, with either "sugar scoop" motor support (F) or combination bedplate (G). Backstop kit (H) can be added to any unit.

A standard wrench assembles or modifies any Moduline unit

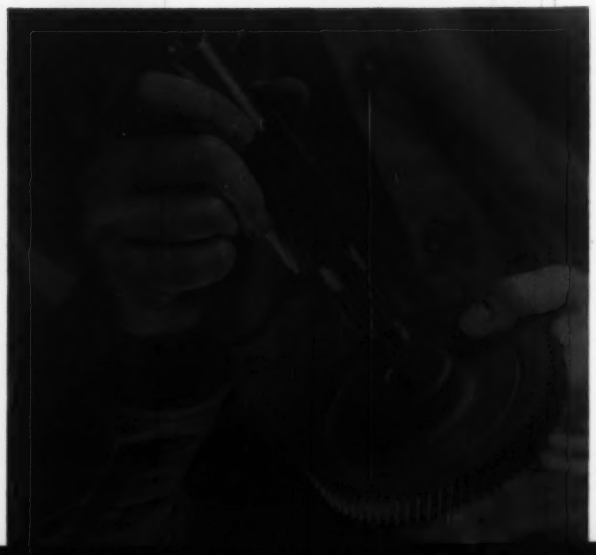
Only a wrench is needed to work on Moduline units. Awkward gear pullers and troublesome fitting have been eliminated. It's another example of the original advantages you gain from Moduline design and quality.

Unusual manufacturing processes, preassembly and pilot fits make modular construction possible. All parts are accurately machined within very close tolerances. No checking, aligning or positioning of modules is necessary during assembly.

Moduline shafts are roll-formed to provide splined and threaded extensions for simple gear mountings. Pinions and gears have splined bores for ease of assembly. An elastic stop nut locks them in position.

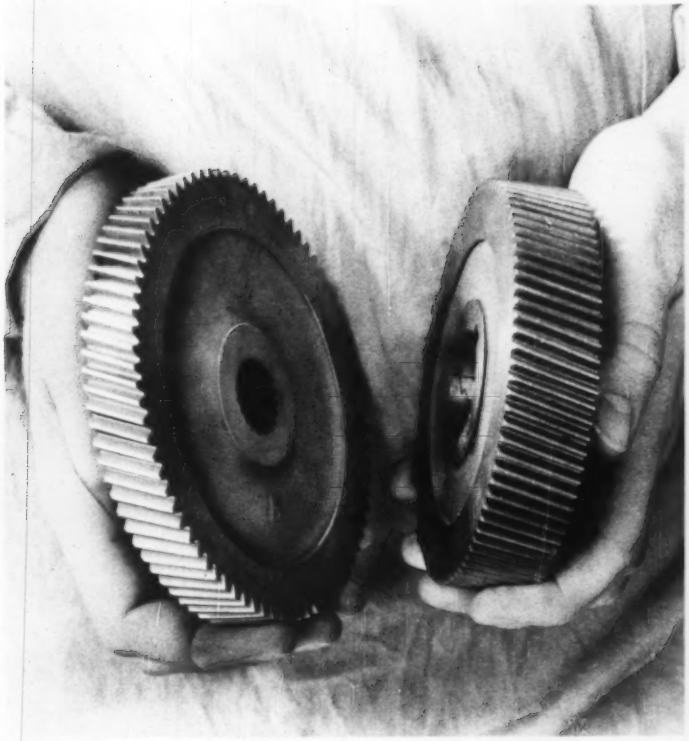
JI-07368-4

WESTINGHOUSE

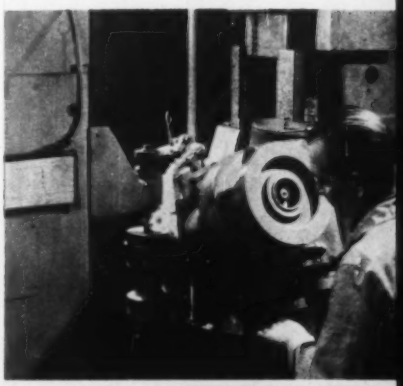


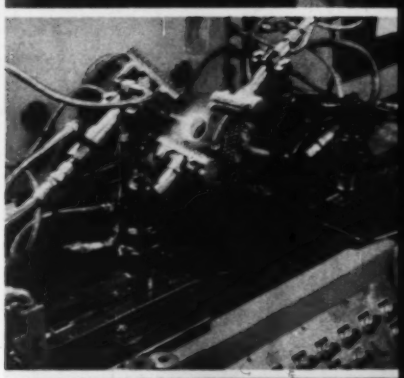
MODULINE

IS ORIGINAL IN DEPENDABILITY



Compare the Moduline ground tooth gear (left) with conventional gear. Note smooth finish, splined bore and drop-forge blank that's standard with all Moduline gears.





(*top*) Precision hobbing cuts Moduline gear teeth on alloy steel blanks

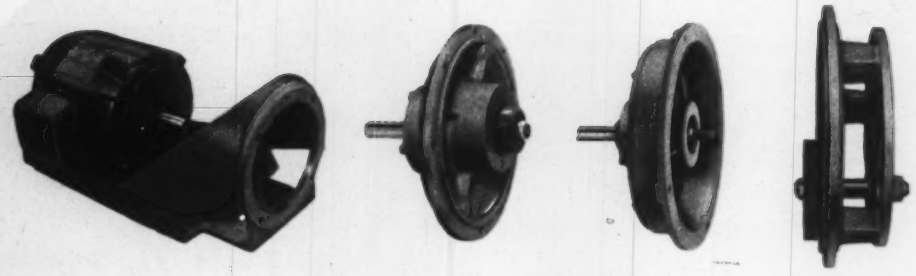
(*middle*) Through-hardening on automatic spin-flame equipment for extra wear resistance

(*lower*) Finish grinding to master gear standards

Only MODULINE combines ground "master gear" precision with tough, wear and shock-resistant alloy steels

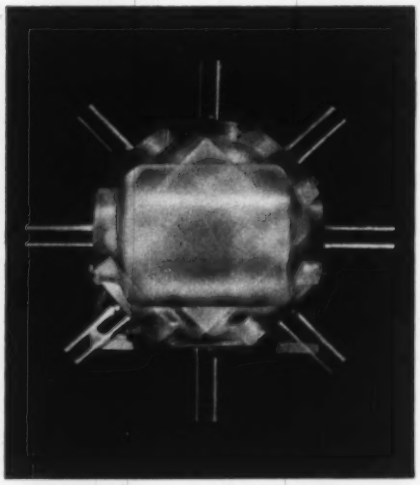
See the difference between a conventional gear and a Moduline precision-ground, heat-treated gear. Moduline gear teeth are so accurate they meet AGMA master gear requirements for pin dimensions, pitch error, profile error and lead error. This means unusual dependability with quiet, efficient operation. Previously, you would have to special-order and pay a premium for the quality now made standard by Moduline. These precision gears have low sound levels and increased mechanical capacity. Spin-flame heat treatment and tempering produce hard, wear-resistant surfaces backed up by tough-hardened cores to stand up under all kinds of service.

JI-07368-5



Moduline originality offers application and maintenance savings

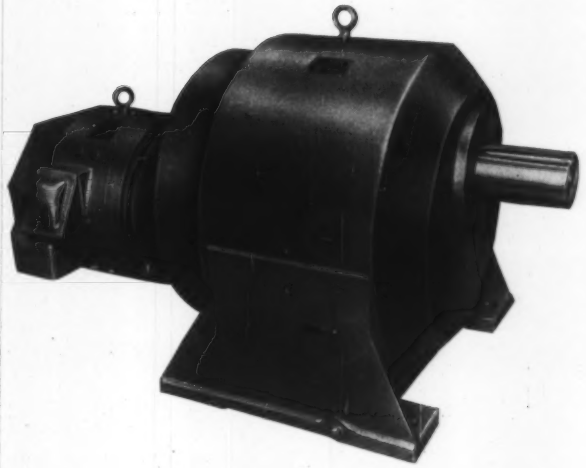
Here are subassemblies for the most versatile gear drives on the market. From these modules . . . concentric shaft or right angle . . . integral gearmotors, package motor reducer drives and speed reducers can be assembled exactly to your specifications. Motor support brackets, right angle heads (in fact, all Moduline parts) go together in thousands of different ways to make the right drive for any job.



Moduline units can be installed in any location. Concentric shaft units can be mounted in any position on the floor, wall or ceiling . . . or at any angle in between. The output shafts of right angle units can be indexed in 8 or 12 positions for power take-off in almost any direction. Units are designed for electric motor or engine drive; chains, belts or gears may be used to put power into or take it out of them. Only Westinghouse offers Moduline units with right angle input or output assemblies. These 1 to 75 hp reducers with ratios from 7.6:1 to 985.3:1 can handle any job.

JI-07368-3

WESTINGHOUSE ELECTRIC CORPORATION



NOW . . . GREATER CAPACITY than any other standard gearmotor . . . and in smaller space!

Capacity up to 200 hp loads, with ratios up to 440:1—that's what you get with the new Philadelphia Type "G" Gearmotor. No other standard gearmotor or in-line reducer on the market offers such high capacity and rugged construction. Yet its compact design gives you the smallest possible power package for any job. The Type "G" is the answer for any application demanding heavy duty, continuous service performance.

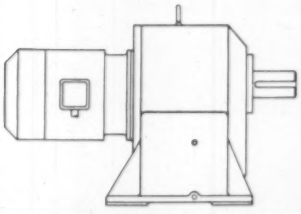
Compact Design. "Shaft-in-line" design makes the new Type "G" Gearmotor more compact and permits complete flexibility in mounting. *Result:* substantial savings in space required. You can even mount the Type "G" without a base plate.

Helical Gearing supports larger loads with maximum power efficiency (96-98%)—assures silent operation, increased strength, longer life. Teeth are crown shaved and induction hardened for optimum performance.

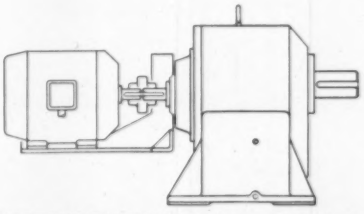
The Type "G" Gearmotor is an extension of the famous Philadelphia Gearmotor Line. It is available as a reducer, gearmotor with motor mounting bracket, or standard gearmotor with flange mounted motor. For complete information, write for Bulletin GM-57-B, Philadelphia Gear Works, Erie Ave. and G Street, Philadelphia 34, Pa.

Offices in Principal Cities • Virginia Gear & Machine Corp., Lynchburg, Va.

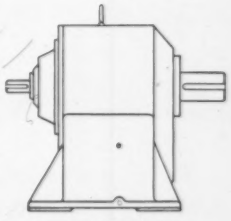
phillie gear®



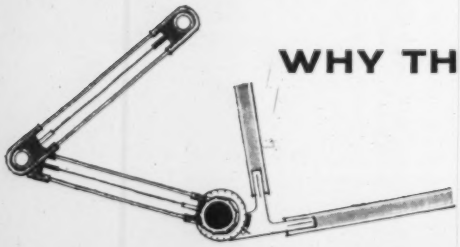
INTEGRAL GEARMOTOR (Flange Motor)



UTILITY GEARMOTOR (Foot Mounted Motor)

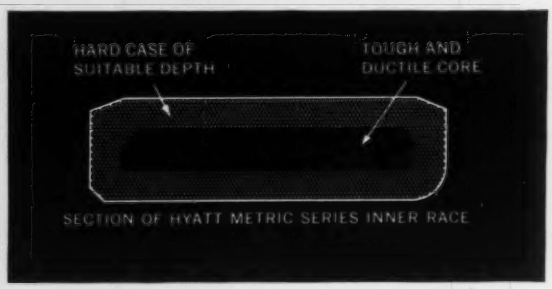


IN-LINE REDUCER

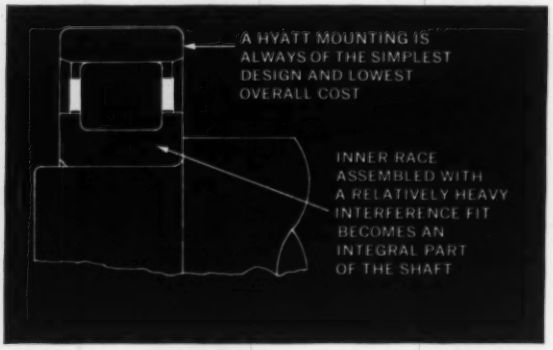


WHY THINGS RUN SMOOTHER WHEN YOU SPECIFY HYATTS

1. CARBURIZING PERMITS HEAVIER INTERFERENCE FITS



2. HEAVIER FITS SIMPLIFY MOUNTING, REDUCE COSTS


A HYATT MOUNTING IS ALWAYS OF THE SIMPLEST DESIGN AND LOWEST OVERALL COST
INNER RACE ASSEMBLED WITH A RELATIVELY HEAVY INTERFERENCE FIT BECOMES AN INTEGRAL PART OF THE SHAFT

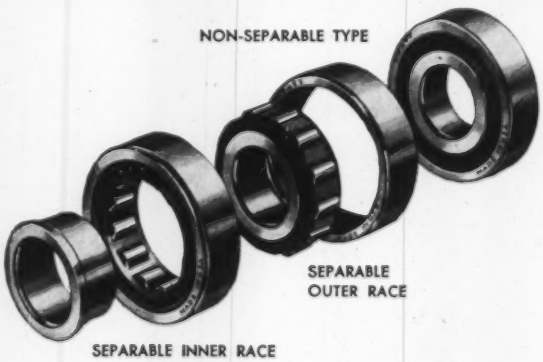
HYATT PIONEERED THE USE OF CARBURIZING TYPE ALLOYS IN ORDER TO OBTAIN THE ADVANTAGES OF HEAVIER RACE FITS

To obtain the best possible performance, roller bearing races must be assembled on shafts and in housings with fits developed by design and experience. The most frequent condition to be met is a rotating shaft where specific load and speed conditions must be satisfied with appropriate race fits. These vary according to the manufacturer, and in the case of some manufacturers, according to the application. Naturally, the fits will also vary according to bearing type and size. How HYATT achieves the optimum in heavier race fits is detailed at right.

You will find full selection and application data in HYATT Catalog 150, or call your nearest HYATT Sales Engineer. Hyatt Bearings Division, General Motors Corporation, Harrison, N. J.; Pittsburgh; Detroit; Chicago; and Oakland, Cal.

1 With the standard metric series of cylindrical roller bearings there is a choice of two fitting practices: (1) Inner races of through-hardening steel, which dictates fairly light interference fits to avoid splitting. (2) Inner races of low carbon steel carburized and hardened to develop a suitable surface hardness and a tough ductile core. The latter permits much heavier interference fits and eliminates holding devices, because the race becomes practically an integral part of the shaft.

2 HYATT originated the carburized race and relatively heavy inner race fits to simplify bearing mounting and eliminate retaining devices. Practically all HYATT inner races are made from nickel alloys of the carburizing type. They permit the simplest kind of mountings and lowest overall cost, and their shoulders will withstand considerably greater impact loads than those of through-hardened races.



THE RECOGNIZED LEADER IN CYLINDRICAL BEARINGS

1908–1958

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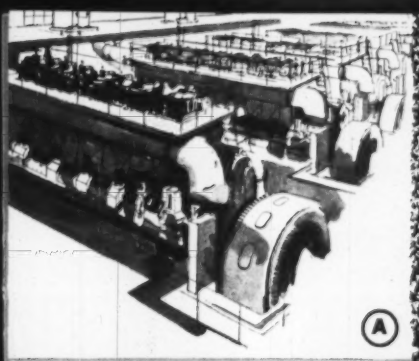
FROM THE PROGRESS OF THE PAST ... THE PROMISE OF THE FUTURE

HYATT HY-ROLL BEARINGS FOR MODERN INDUSTRY



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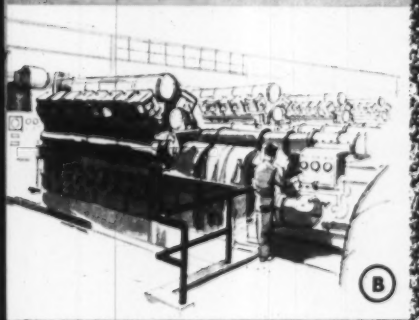

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Since 1886... NORDBERG has been "partners" with Industry ...through the DESIGN, MANUFACTURE and SERVICE of QUALITY MACHINERY

Ⓐ Nordberg 2-cycle Diesel, Duafuel® and Natural Gas Engines, in sizes to over 11,000 hp, are used the world over for light and power for industrial, marine and utility service.

Ⓑ Nordberg 4-cycle Diesel, Duafuel and Natural Gas Engines, in sizes to 4,500 hp, deliver low cost, reliable power for pipe line pumping, industrial services, and for a wide range of marine applications.

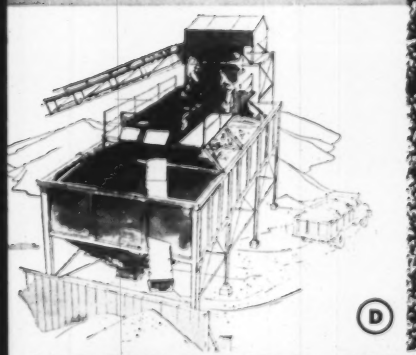
Ⓒ Symons® Cone and Gyratory Crushers are the best choice for low cost, large volume crushing of ores, minerals and rock products.

Ⓓ Symons Vibrating Grizzlies and Screens offer high capacity, long life service in all types of sizing operations from scalping to fine screening in the mining, quarrying and construction industries.

Ⓔ Nordberg Grinding Mills, Kilns and allied processing machinery is built for low cost, high capacity service in the mining, rock products, cement and chemical industries of the world.

Ⓕ Nordberg Track Equipment is used by the railroads of the world providing better maintenance of track, ties and roadbed at lower cost per mile.

We welcome your inquiry and the opportunity to show you how Nordberg Machinery can benefit you as it has so many others.



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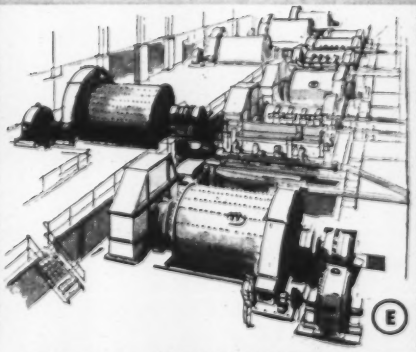

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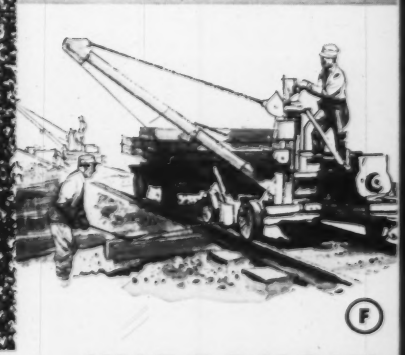

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NORDBERG MFG. CO., MILWAUKEE 1, WISCONSIN

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LONDON • MEXICO, D.F.

NORDBERG MACHINERY

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AP258

rigid specifications

Tension tests are required to be made at room temperatures and at 670° F. The following minimum physical properties shall be met:

At Room Temperature:

TS	YS	EL	RA	CHARPY V-NOTCH
70,000	30,000	45	50	50

At 670° F. the minimum tensile strength shall be 51,000 p.s.i. and the minimum yield strength 18,300 p.s.i.

Rejection

Each casting that develops unacceptable defects during shop working or fails to conform to all of the requirements of these specifications shall be rejected. No repair by welding or other means will be permitted.

Radiographic Inspection

(a) Paragraph S5 (a) of the Supplementary requirements of ASTM-A 362-52T.

(b) All castings shall be radiographed 100% and shall conform to ASTM-E7 1-52, Class 2 quality, except as modified by these specifications.

(c) The manufacturer shall establish a positive system of identification of the X-ray plates which shall be subject to approval by the inspector. This system shall guarantee complete coverage by radiographing and provide for positive identification between the plate and the subject.

Inspection of Penetrants

All castings shall be subjected to inspection by fluorescent penetrants or penetrating dyes both inside and out. All cracks, porosity, or flaws revealed as a result of the Dye Penetrant Test shall be due cause for rejection of the casting.

All cast pipe shall be hydrostatically tested to 5,900 p.s.i. and held at that pressure for 20 minutes with zero pipe leakage. Each length of pipe shall be hydrostatically tested at the manufacturer's plant.

The 304L stainless steel shall conform to the following ladle analysis:

Carbon	.03 max.		
Manganese	1.50% max.		
Phosphorous	.03% max.		
Sulphur	.03% max.		
Silicon	2.00% max.		
Chromium	18.00	-	21.00%
Nickel	8.00	-	11.00%

Pipe: All pipe of the following sizes shall be centrifugally cast stainless steel as per ASTM-A 362-52T, except as modified by these specifications:

16" - Sch. #160
12" - Sch. #160
10" - Sch. #160
8" - Sch. #140

All pipe shall be machine finished to 125 micro-inch interior and exterior.

for nuclear piping met by U.S. PIPE metal mold process

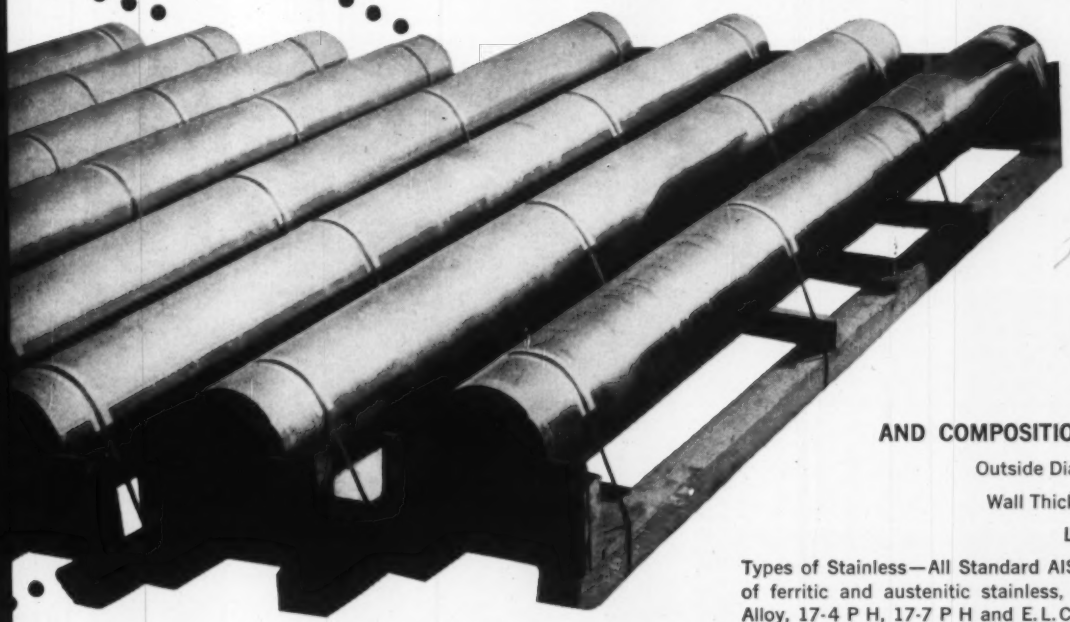
Centrifugally Cast Stainless Steel Solves Many Piping Problems

Combinations of temperatures, pressures and corrosive conditions never encountered before: these are among the piping problems that must be overcome by the men who design the nation's nuclear power installations.

Stainless steel centrifugally cast pipe provides many of the answers. Study the specifications at the left . . . specifications demanded of stainless steel pipe on a recent job for Paul Hardeman, Inc., Los Angeles, California. This pipe is being used for heavy duty, high pressure, elevated temperature service in the primary piping system of the SPERT-III Reactor at the U.S. Atomic Energy Commission's National Reactor Testing Station near Idaho Falls, Idaho. The Stearns-Roger Mfg. Company, Denver, Colorado, is the architect-engineer on this project. A complete tabulation of the actual test data obtained on this pipe and to this specification is available upon request.

U.S. Pipe is headquarters for metal mold centrifugally cast alloy and stainless steel pressure pipe over a wide range of special and standard analyses—in large and small quantities—and to individual specifications.

If piping of the type described above is the bottleneck in your nuclear power planning, write and outline the problem.



SIZE RANGE AND COMPOSITION FLEXIBILITY

Outside Diameter—6" to 50"

Wall Thickness—⅜" and up

Length—Up to 16'

Types of Stainless—All Standard AISI and ACI grades of ferritic and austenitic stainless, including No. 20 Alloy, 17-4 P H, 17-7 P H and E.L.C. grades.

UNITED STATES PIPE & FOUNDRY CO.

Steel and Tubes Division

STEEL & TUBES U.S. PIPE DIVISION

BURLINGTON, NEW JERSEY

SALES OFFICES: LOS ANGELES, SAN FRANCISCO, CHICAGO, ST. LOUIS, COLUMBUS, PITTSBURGH, RAYMOND, BURLINGTON

"OUT IN THE OPEN"

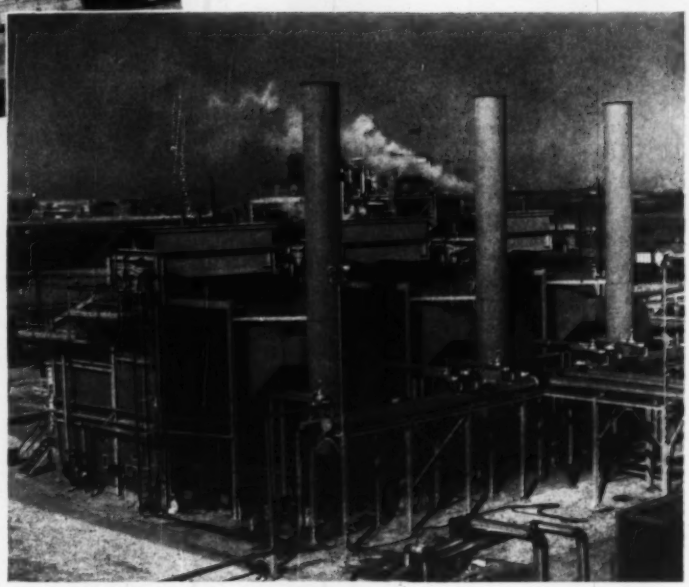
Vogt Steam Generators

STEAM GENERATORS for economical outdoor operation have been featured by Vogt for many years and serve leading chemical plants and petroleum refineries. Requiring no building for housing, such installations, as pictured here, produce more steam per dollar of investment and are a definite aid to lower production costs.

Get Vogt's recommendations for steam generators to meet your needs for power, processing, or heating, without obligation. Package type and custom built units are available in a wide range of types, capacities, and pressures to meet operating requirements.

Write for bulletins. Dept. 24A-BM.

Three 85,000 #/hr. steam generators in a Texas refinery.



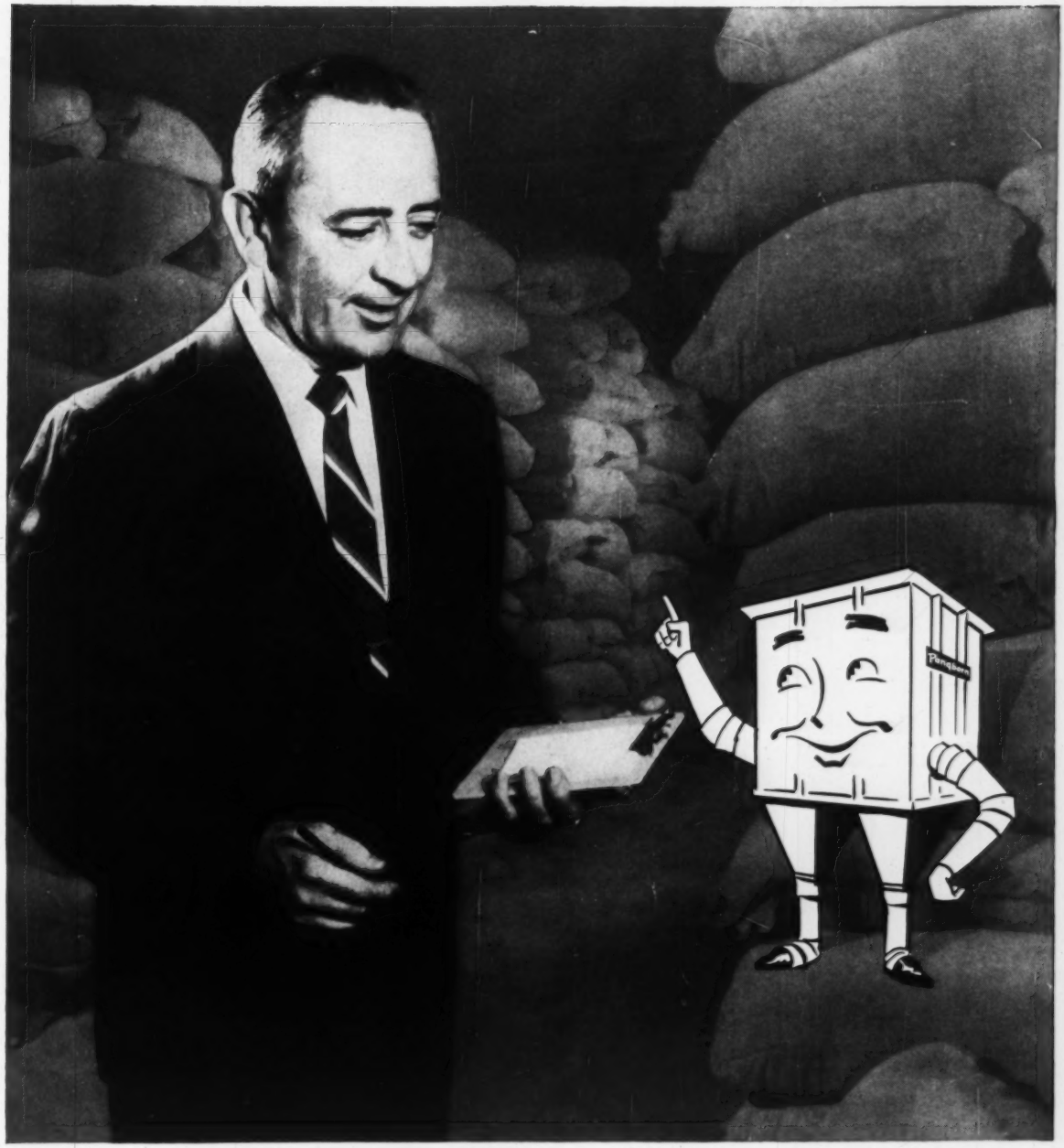
An outstanding chemical plant served by three 150,000 #/hr. units.

OTHER VOGT PRODUCTS

Drop Forged Steel Valves, Fittings and Flanges — Petroleum Refinery and Chemical Plant Equipment Heat Exchangers Ice Making and Refrigerating Equipment

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

SALES OFFICES: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va., Cincinnati



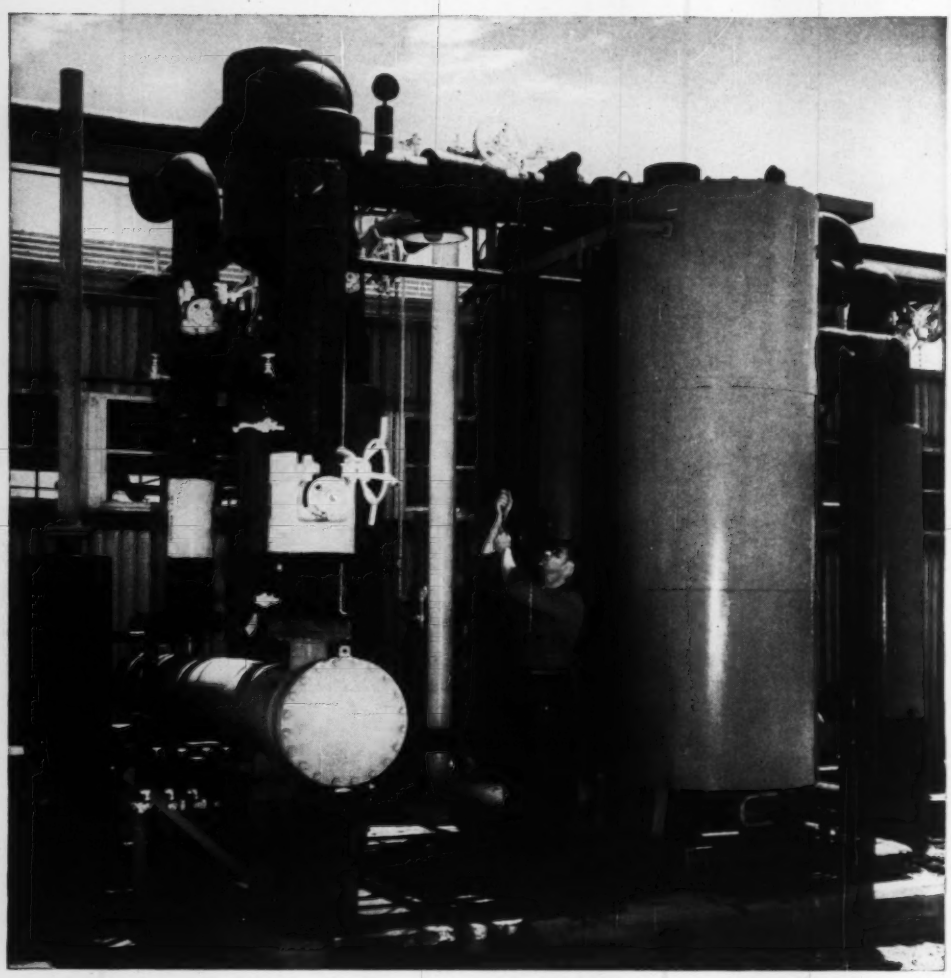
"You mean $15,000 a year salvaging dust?"

That's just what we mean! Many of our customers are clearing $15,000 a year and more from valuable material reclaimed by Pangborn Dust Control. Efficient Pangborn Dust Collectors trap dust at the source, gather it ready for resale, re-use or disposal. As a matter of fact, users of Pangborn Dust Control have made $20,000, $36,000, even $75,000 a year in salvaged dust, depending on the value of the dust collected.

What's more, Pangborn gives you other benefits of lower housekeeping costs, longer machinery life, higher employee efficiency and better employee and community relations. And Pangborn offers a complete line of collectors for all jobs.

Why not discover how you can profit from Pangborn Dust Control? Write for Bulletin 922 to PANGBORN CORP., 2200 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control & Blast Cleaning Equipment.*

Pangborn CONTROLS DUST



Type BWC Lectrodryer on-stream at Hooker Electrochemical Company, Montague, Mich.*

DRY hydrogen required for production and pipeline transmission

Hydrogen, a by-product from electrolysis of sodium chloride brine, is used for producing anhydrous HCl gas. It must be DRY for this purpose, so Hooker Electrochemical passes it through this Lectrodryer*.

This DRYing also makes it possible to transmit the gas through uninsulated pipes during cold weather. There's no moisture in the hydrogen to cause freezeups.

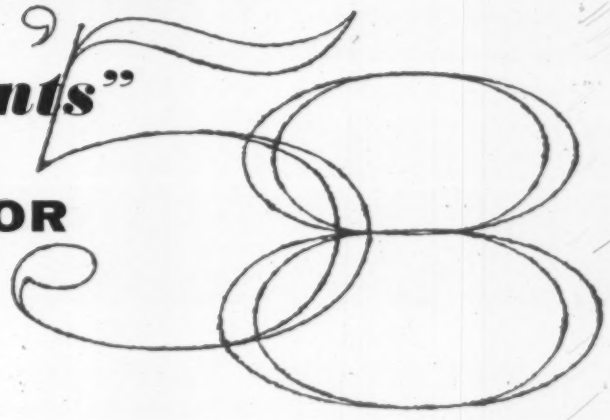
On-stream continuously, the Lectrodryer handles this DRYing without interruption. Its valves are reversed every eight hours, putting one tower on DRYing while the other is being regenerated. No other attention is required.

Because Moisture Isn't Pink tells how others are using Lectrodryers. For a copy, write Pittsburgh Lectrodryer Division, McGraw-Edison Company 335 32nd St., Pittsburgh 30, Pa.

Lectrodryer

*REGISTERED TRADEMARK U. S. PAT. OFF.

COMBUSTION'S SCHEDULE OF "Main Events" FOR 58



Dedication of World's Largest, Privately Owned, Integrated Facilities for Nuclear Research, Development and Manufacture

C-E's $15,000,000 Nuclear Division at Windsor, Connecticut. Ground broken December 1955; construction completed in late '57; dedication in Spring of '58.

Construction of Nuclear Submarine Prototype

At C-E Nuclear Division, Windsor, Connecticut. First nuclear submarine prototype to be designed and built at other than AEC-owned facilities.

Shipment of Largest and Most Complex Nuclear Vessel Built to Date

Reactor vessel for Enrico Fermi Nuclear Power Station.

Completion of Manufacture of World's Highest Pressure, Highest Temperature Boiler

5000 pounds per square inch; 1200 deg. Fahr.

Engineering and Partial Manufacture of World's Largest Boiler

First boiler ordered to serve a turbine generator with a capacity as high as 500,000 kw.

Completion of Installation of World's Highest Capacity, Highest Pressure, Highest Temperature Package Boilers

Two completely shop-assembled boilers, one with a capacity of 100,000 pounds of steam per hour, and one to operate at a pressure of 1800 pounds per square inch and 1050 deg. Fahr.

These are some of the achievements which will maintain Combustion's leadership in 1958 in its major field — the creation and building of advanced designs of equipment for the generation of power or heat from conventional or nuclear fuels.

And, in another significant area, Combustion expects to set a new record this year — *the largest volume of shipments and billings in its history.*

COMBUSTION ENGINEERING

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C-E

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ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING EQUIPMENT; PRESSURE VESSELS; SOIL PIPE

Another CONDENSER designed and built by MARIND

In ever growing numbers, Marind Condenser installations are earning a well deserved reputation for efficient, dependable performance. Designed and built by thoroughly experienced engineering and manufacturing personnel, Marind power equipment products enjoy a reputation for outstanding quality. We have in process of construction units to suit turbo generators to 156 megawatts, and are capable of processing steam surface condensers to any size.

Industrial Products Division

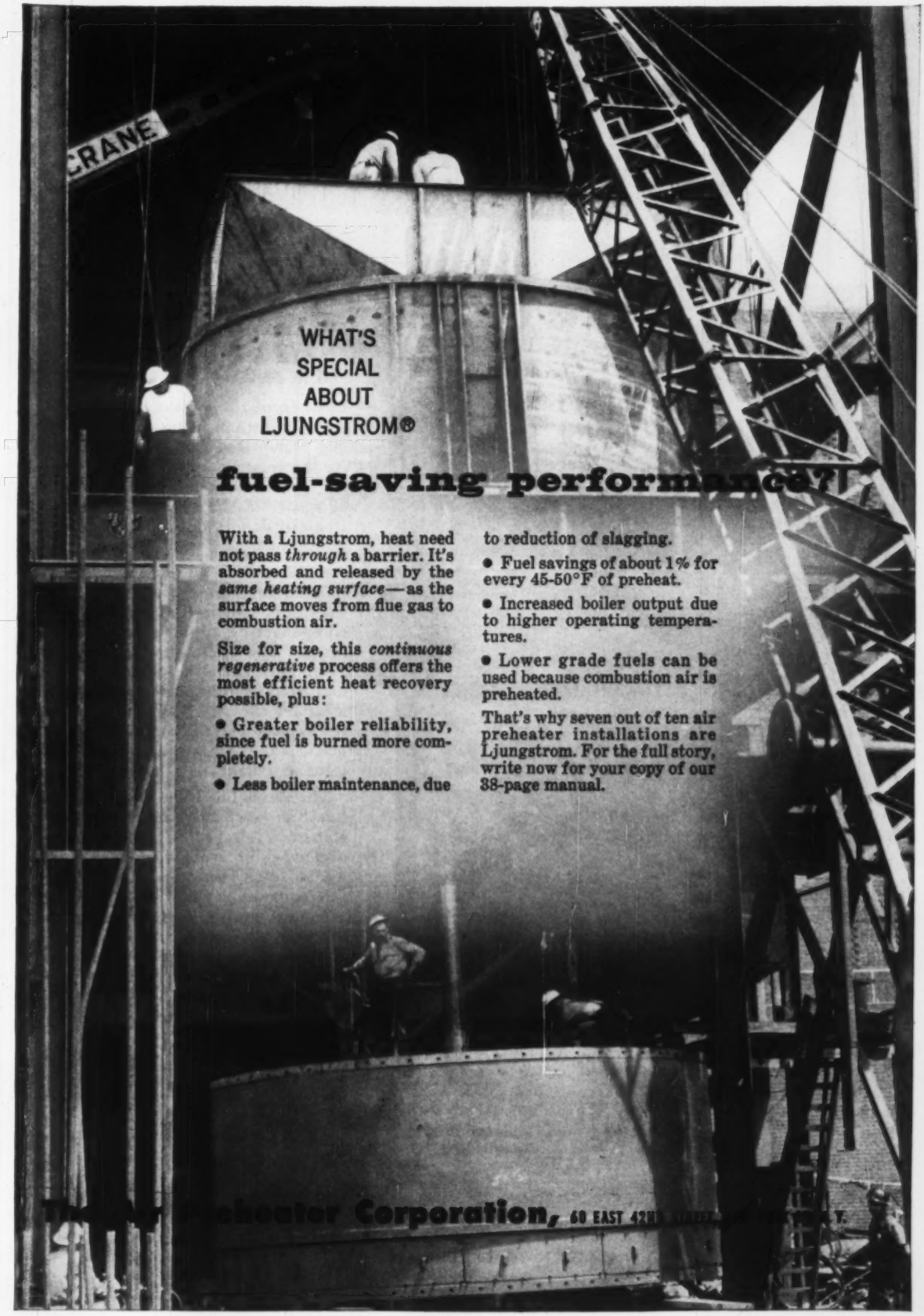
MARYLAND SHIPBUILDING & DRYDOCK COMPANY

BALTIMORE 3, MARYLAND • *Representatives in Principal Cities*

MARIND

STEAM CONDENSERS AND AIR EJECTORS

for stationary power plants and marine service



WHAT'S SPECIAL ABOUT LJUNGSTROM®

fuel-saving performance?

With a Ljungstrom, heat need not pass *through* a barrier. It's absorbed and released by the *same heating surface*—as the surface moves from flue gas to combustion air.

Size for size, this *continuous regenerative* process offers the most efficient heat recovery possible, plus:

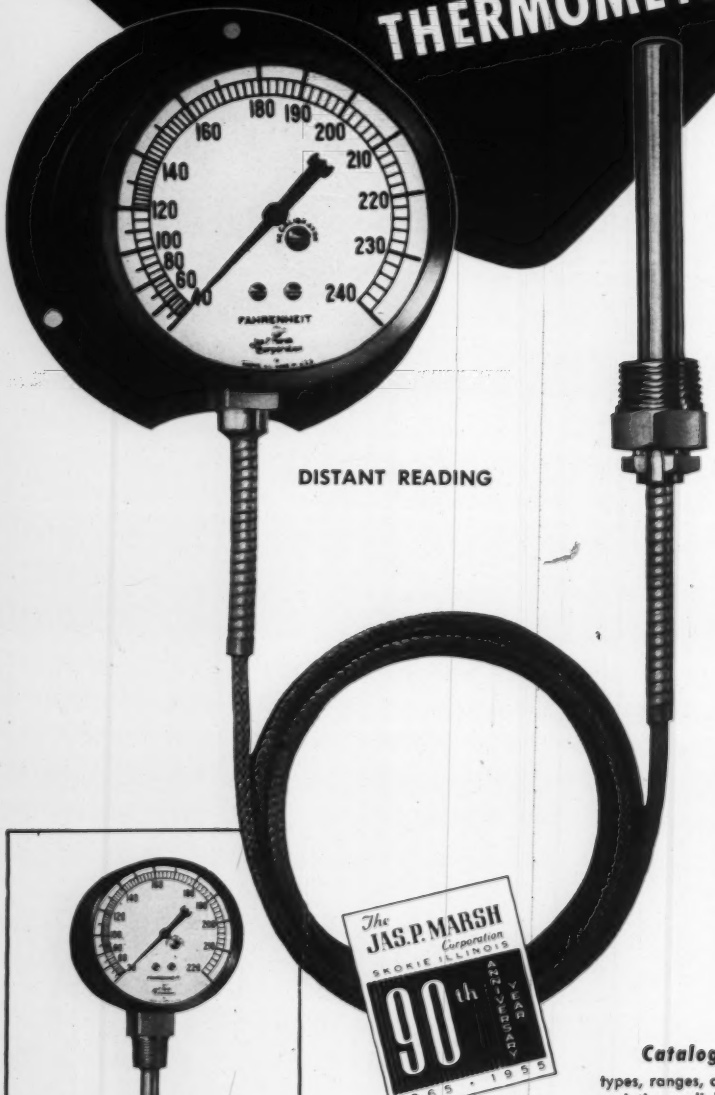
- Greater boiler reliability, since fuel is burned more completely.
- Less boiler maintenance, due to reduction of slagging.
- Fuel savings of about 1% for every 45-50°F of preheat.
- Increased boiler output due to higher operating temperatures.
- Lower grade fuels can be used because combustion air is preheated.

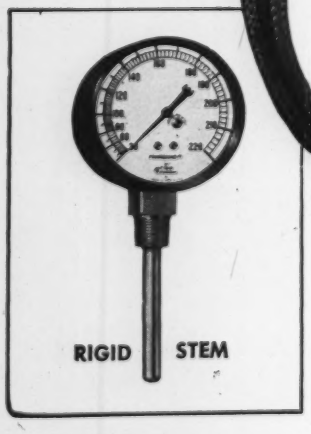
That's why seven out of ten air preheater installations are Ljungstrom. For the full story, write now for your copy of our 38-page manual.

[illegible] heater Corporation, 60 EAST 42[illegible] STREET, [illegible] Y.

MARSH

Vapor Tension DIAL THERMOMETERS





The JAS. P. MARSH Corporation
SKOKIE ILLINOIS
90th ANNIVERSARY YEAR
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Wider range of application

...TIME PROVED MARSH QUALITY

The best of all we have learned in 90 years of instrument making has gone into Marsh Dial Thermometers. They are the versatile, vapor tension type—the type that covers the widest range of needs . . . brought to the highest stage of development in the broad Marsh line.

Ambient temperatures have no effect on dial readings of Marsh Vapor Tension Thermometers. Therefore no compensating adjustments are ever needed. The distant reading type will give highly accurate readings even when located far from the point of temperature measurement. All thermometers have the famous Marsh "Recalibrator"—quickest and best way to keep an instrument accurate.

The Marsh line is the most complete line: Rigid stem thermometers are available in dial sizes of 2½", 3½" and 4½"; distant reading types in sizes of 2", 2½", 3½", 6", 8". All are made in 12 different ranges reading as low as —40° F. and as high as 350° F., and in scale lengths to cover all services. An outstanding contribution to their practical application is the wide range of bulb types available to suit all services. Cases are available in patterns for all mountings and in black steel, polished brass, nickel and chromium plate.

Catalog covers all details — types, ranges, case patterns, dimensions, bulb variations, dial graduations. Write for it.

MARSH INSTRUMENT CO., *Sales affiliate of Jas. P. Marsh Corporation*
Dept. 29, Skokie, Ill.

Marsh Instrument & Valve Co., (Canada) Ltd. • 8407 103rd Street, Edmonton, Alberta, Canada

Why Every Steam Heated Unit Needs its Own Steam Trap

. . . the theory, practice and proof of "unit trapping" for top temperatures

Using an individual trap for each steam heated unit, including each separate coil, chest or chamber of a machine—pays off for the user. Here are just two examples:

1. On a creamery dryer

Drainage Method	*Air Temperature*
Restricted Blow-thru	250°
Group trapping (1 trap for 8 coils)	225°
Armstrong Unit Trapping (8 traps—1 for each coil)	**309°**

2. On a platen press

Drainage Method	*Processing Time*
Restricted Blow-thru	50 minutes
Group Trapping	35 minutes
Armstrong Unit Trapping	**25 minutes**

Why Unit Trapping Works Best

It is reasonable to assume that no two steam heated units will have *identical* condensing rates. Even the slightest difference in rate will cause a difference in steam pressure drops through the units. Here's where the trouble starts. Condensate from each unit may flow to the trap. But, what about air and other non-condensibles in the system? A difference in pressure drops too small to be indicated by an ordinary pressure gauge will permit backflow of steam from the higher pressure units to the lower pressure units. This backflow of steam may even impede flow of condensate from the lower pressure unit to the trap . . . and it will definitely impede or block off flow of air to the trap. The result is sluggish heating, reduced temperatures, reduced output, fuel waste and increased possibility of corrosion. Figures 1, 2 and 3 diagram the action.

Unit Trapping Not Costly

No engineer wants any more mechanical devices in his plant than are absolutely necessary. But, the moderate additional cost of using two or more small traps, instead of one big one, is saved over and over again in improved efficiency.

If the traps are Armstrong, maintenance is no problem. And users frequently tell us that Armstrong traps outlast others two and three to one.

Steam traps usually represent a fraction of 1% of the cost of the equipment they drain. Does it make good sense to lose 10% or more of equipment capacity to save a few dollars on traps?

Why not test Armstrong unit trapping in your plant. If you are not completely satisfied with the results you can return the traps for a full refund of the purchase price. There is little to lose—lots to gain. Call your local Armstrong Factory Representative or Distributor, or write **Armstrong Machine Works, 8941 Maple St., Three Rivers, Mich.**

ASK FOR the 44-page Steam Trap Book and reprint of article on Unit Trapping.

801ST

How Different Condensing Rates Can Slow Production

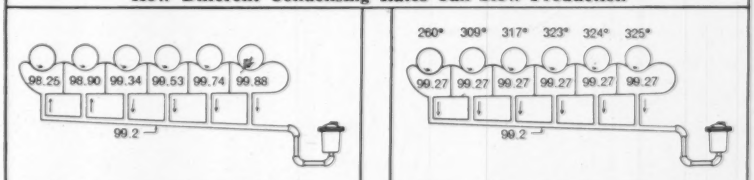


Fig. 1 This is a 6-roll ironer shortly after it has begun operating on 100 psi steam. When cold, wet material passes over chest 1, steam condensing rate is high and pressure drops accordingly. The pressure drop in chest 2 will not be as great, and so on down the machine as the material becomes progressively hotter and drier. Average pressure in the chests then is 99.27 lbs., and drain header pressure is slightly less, about 99.2 lbs. Under these conditions, steam from drain header enters chests 1 and 2 (as indicated by arrows at side of drain lines) because of pressure difference. Though condensate from chests drains by gravity, air can't leave chests countercurrent to incoming steam. Fig. 2 shows what happens next.

Fig. 2 This is the same 6-roll ironer after it has been operating a while. Air has accumulated in chests 1 and 2, reducing condensing rate and decreasing pressure drop. This process repeats itself down the line until pressures are as shown—that is, enough air will accumulate in each chest so that condensing rates and pressure drops of all chests will be about equal. The net result is shown in chest temperatures which are actual pyrometer readings taken on a 6-roll ironer, drained by a master trap, in a Chicago laundry. The laundry was making 337.9°F steam, but getting an average of only 309.6°F from the ironing surfaces, necessitating slow operation and frequent reruns. Then they tried Armstrong unit trapping—see Fig 3.

How Unit Trapping Prevents Trouble

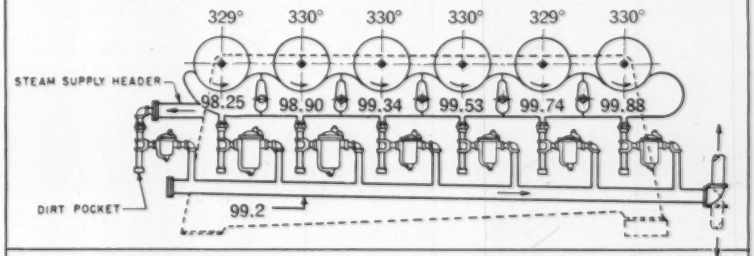
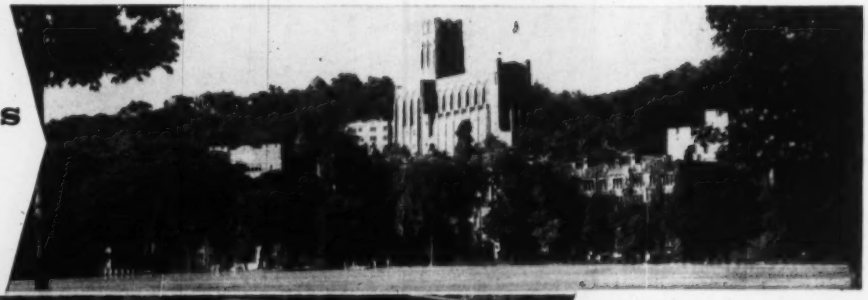
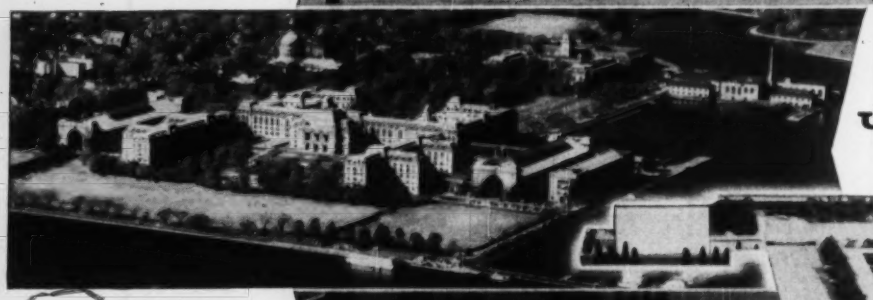


Fig. 3 This is the same 6-roll ironer, now unit trapped. Temperatures shown are also actual pyrometer readings—the average of 329.6°F is 20° higher than with group trapping. This is because air is continually removed from each chest into the drain header, and cannot get back into any chest.

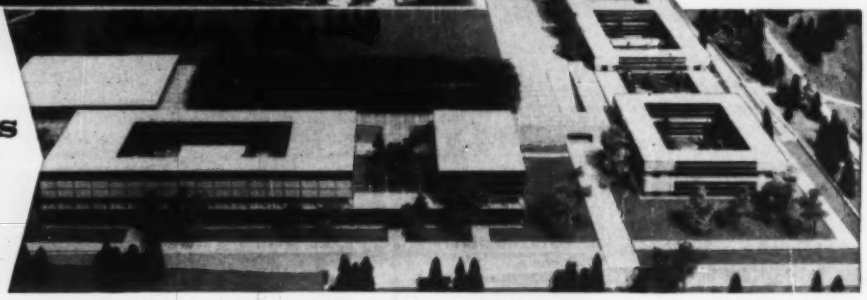
ARMSTRONG STEAM TRAPS



UNITED STATES MILITARY ACADEMY



UNITED STATES NAVAL ACADEMY



UNITED STATES AIR FORCE ACADEMY

Photographs courtesy United States Military Academy, United States Naval Academy, and United States Air Force Academy.

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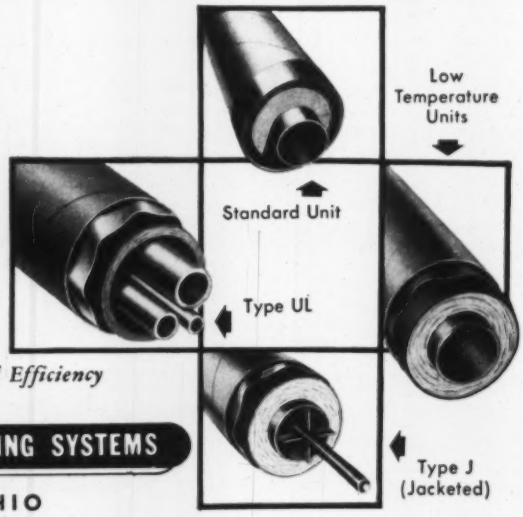

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Drilling mud, containing sand and rock particles, looks like this as it flows from a well hole. It is "freshened up" for re-use in a cleaning machine equipped with a wear-resisting Monel alloy screen. *Photo courtesy Standard Oil Company, (New Jersey).*

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MECHANICAL ENGINEERING

VOLUME 80 • NUMBER 2 • FEBRUARY, 1958

James W. Parker

James Wentworth Parker, Fellow, Honorary Member, and 61st President of The American Society of Mechanical Engineers, whose sudden death occurred Dec. 30, 1957, at the age of 71, devoted his life to the advancement of power engineering and to unselfish service to the engineering profession. His insight and vision had breadth and penetration, tempered by the warmth of human kindness, forbearance, and understanding. The gracious and close attention he accorded to others, the friendliness of his smile, the calm but persuasive manner of his speech, the impulsive upward toss of his head with which he greeted a jesting remark, will long be remembered and were evidences of an ingrained urbanity and gentility. An inherent yet unobtrusive dignity, which to one observer at least, he appeared never to lay aside, was enriched by natural modesty and cordiality so that, in spite of the high positions he held and the many honors conferred upon him, one never hesitated to call him Jim.

Born in Auburn, N. Y., Nov. 28, 1886, and educated at the Louisville (Ky.) Male High School, he was graduated from Cornell University in 1908 with the degree of mechanical engineer. His association with the power industry began in August, 1908, at The DeKalb (Ill.) Electric Light and Power Company where he spent a year as apprentice and operating engineer, followed by one year as chief plant engineer, Vincennes (Ind.) Street Railway Company. In February, 1910, he became boiler-room engineer at the famous Delray plant of The Detroit Edison Company, the first technically educated man to be assigned to such duty in that Company. With the exception of one year's service with the War Department in 1918, he remained with The Detroit Edison Company until his retirement, Nov. 30, 1951, after which he was for one year a consultant to the Company which he continued to serve as a director until his death.

Jim Parker's advancement in The Detroit Edison Company was rapid. In 1914 he became superintendent of central heating; in 1917, engineer assistant to the vice-president; in 1923, chief engineer; in 1943, general manager; and in 1944, president. As president and general manager he retained active interest in the engineering phases of the Company's operations in addition to his administrative duties and responsibilities. He took a keen interest in employee problems and in supervising negotiations with unions. In 1913 he was a member of the Committee on Steam Plants of the Association of Edison Illuminating Companies. Later he became a director and in 1946 president of that Association.

When Jim Parker joined The Detroit Edison Company the atmosphere was invigorating to a young man with engineering education and talent. That colorful and independent-minded Scotsman, Alex Dow, Past-President and Hon. Mem. ASME, one of that vigorous breed of electric-utility pioneers, had equipped the Delray plant with the largest steam boilers then in existence. The rapid substitution of steam turbines for reciprocating engines and the growth of the demand for electricity had left the boiler rooms of power plants outmoded and unwieldy in size, with a host of boilers, of a few hundred horsepower each, which in some cases were hand-fired. Dow's boilers were of 2365 hp each with two stokers to each boiler. They generated steam at about 200 psi and 150 deg of superheat. The furnaces were $26^1/_2$ ft wide, 14 ft from front to rear, and a height of 29 ft above the

Editor, J. J. JAKLITSCH, JR.
Editor Emeritus, GEORGE A. STETSON

James W. Parker

dumping grate. The engineering world was eager to know how successful these giant boilers would be. In tests involving about 50 men in three eight-hour shifts for six weeks, in which young Parker participated, efficiencies were obtained ranging from 90 per cent at 93 per cent of rating to 76 per cent at 214 per cent of rating. The results of these tests were reported to ASME in 1911 in a memorable paper by D. S. Jacobus; and supplementary tests were reported by Parker himself at the 1913 Annual Meeting, his first ASME paper, presented ten months after he had become a Junior Member of the Society. The race for size was on, with the object of a one-boiler, one-turbine unit. And as soaring steam temperatures and pressures brought new problems for solution, Jim Parker and his colleagues made important contributions to a rapidly advancing art.

More recently, since practice continues to outstride knowledge, Parker became chairman of the ASME Research Committee on Properties of Steam, a post Geo. A. Orrok and Alex Dow had occupied on a committee of the same name which performed so brilliantly in the 1920's and the 1930's and laid the basis for our present steam tables. Always the man of vision, Parker kept his company abreast of developments in the power field. He was quick to foresee the possibility of the peaceful uses of nuclear energy in the generation of electricity, and was instrumental, as chairman of the Industry Advisory Group of the U. S. Atomic Energy Commission, in events which led to the release of the Commission's data and experience for industrial applications and in urging his own company to pioneer in nuclear power plants.

Jim Parker held high ideals for engineers and their profession. A considerable portion of his time and energy was given over to engineering education, engineering societies, committee assignments, community welfare, and directorships. He served two terms as alumni trustee of Cornell University and two as a member of the Engineering Council of that institution.

An honorary member of The Engineering Society of Detroit, he was its president when the Rackham Educational Memorial was planned and built. He was elected a permanent trustee of the Rackham Engineering Foundation in 1945. His belief that engineers should play an active part in the solution of civic problems led him to encourage the establishment of the Civic Affairs Committee of The Engineering Society of Detroit, whose service to the Detroit area and method of operation have been patterns for applications in other communities.

Jim Parker's enthusiasm for the aims and programs of Engineers' Council for Professional Development impelled him to accept many assignments in that organization, including the chairmanship from 1946 to 1949. In his 1948 report to the Council he stated: "It is clear that adequate forces must be organized in each community in which the Committee on Professional Training plans to establish its educational program for recently graduated engineers." But he modestly made no mention of the fact that it was his own efforts and enthusiasm which persuaded A. C. Monteith, Hon. Mem. ASME, to assume chairmanship of that committee whose exhaustive studies and plans led to the setting up of the program, known as "The First Five Years of Professional Development," in Cincinnati.

Jim Parker's personal services to ASME began with his appointment by the Council in 1916 to the Power Test Codes Committee and as first secretary of the Detroit Section. His qualities and talents led to assignments of ever-increasing importance, culminating in the Presidency, 1941–1942, and continuing thereafter up to the day of his death.

This brief and inadequate tribute cannot even list numerous positions of trust and service Jim Parker held in Society, community, national, and business affairs. The best it can hope to do is to remind his friends and the engineering profession of the debt they owe to a man who combined vision with an ability to get things done.—*George A. Stetson.*

A FUNCTIONAL ORGANIZATION FOR THE ENGINEERING PROFESSION

By W. J. Barrett[1]

President, American Institute of Electrical Engineers
President, United Engineering Trustees

It has been called the AIEE Plan, Coover Plan, San Francisco Plan. This report clarifies the intent, and removes misunderstandings.

I HAVE been amazed at how widespread seem to be certain misunderstandings about the action taken by the AIEE Board of Directors in San Francisco, Calif., in June, 1956, and at the number of incorrect statements concerning it which have appeared in the press.

The purpose of this article will be to attempt to clarify the situation and to remove some of the misunderstandings.

To begin, let me meet some of the misstatements head-on by stating certain things which the AIEE Board action did not do.

1 It did not propose that AIEE discontinue any of its interests, give up any of its activities, or put an end to any of the types of services it has been performing on behalf of its members, including students.

2 In proposing some realignment of responsibilities as among Engineers Joint Council (EJC), Engineers' Council for Professional Development (ECPD), and National Society of Professional Engineers (NSPE), it did not impose any condition whatever. For instance, it did not specify as a condition of this realignment that NSPE should open its membership rolls to nonregistered engineers.

3 It did not propose that NSPE become a constituent society of either EJC or ECPD.

4 It did not propose that EJC and ECPD combine.

5 It took no position with regard to the establishment or nonestablishment in the immediate future of an over-all unity organization for the engineering profession.

Now that we have seen some of the things which the AIEE Board action did not do, let us turn to the positive side and examine just what this action did propose.

Having observed the functioning of the various organizations in the engineering profession for a long time, and having discussed the problem of how the profession should best be organized, not once, but at practically every one of its meetings for several years, the Board on June 28 in San Francisco spent considerable time, as a "Committee of the Whole," discussing the matter in some detail. One thing which had been a cause of concern to the Board was the overlapping of certain of the

[1] Mr. Barrett is with New Jersey Bell Telephone Company, Newark, N. J. Reprinted from the February, 1958, issue of *Electrical Engineering*.

A MESSAGE FROM THE ASME PRESIDENT

The Council on Nov. 30, 1957, approved the recommendation of the ASME Organization Committee to endorse the AIEE plan (see MECHANICAL ENGINEERING, July, 1957, p 693) for the functional organization of the engineering profession. In the February issue of Electrical Engineering Mr. Barrett gives a clarification of the AIEE proposal which is so basic that it merits concurrent repetition in MECHANICAL ENGINEERING as informational material to help ASME members reach and voice their opinions on this important question.

I request you to give AIEE president Barrett's message very careful consideration and urge you to write me at ASME headquarters, 29 West 39 St., New York 18, N. Y., your views and questions as part of a democratic and systematic procedure to develop member opinions on this suggested functional organization of the engineering profession. Your views will be very useful for Society guidance.

JAMES N. LANDIS, President
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

A FUNCTIONAL ORGANIZATION FOR THE ENGINEERING PROFESSION

activities of EJC with those of ECPD and of NSPE. Such duplication was considered highly undesirable, because it could lead to confusion and a loss of effectiveness. The conclusions reached by the Committee of the Whole were summarized in four recommendations. Immediately upon reconvening, the Board of Directors took action on these four items. I think it will be well to quote the four Board actions and discuss each of them briefly. The Board

1 "VOTED to adopt in principle, and actually to support three organizations of a character approximating the present EJC, ECPD, and NSPE with certain functional modifications (as recommended by the Committee of the Whole) as currently most suitable to serve the over-all needs of the engineering profession.
2 "VOTED to request the President to appoint a special committee to draft, subject to Board approval, a statement to the membership and other interested parties, setting forth the proposed AIEE position on intersociety relations as recommended by the Committee of the Whole.
3 "VOTED to request the President to appoint a committee with instructions to approach NSPE with the suggestion that its membership be opened, for a period of years, to unregistered engineers holding suitable grades in technical societies subscribing to ECPD uniform membership grade standards.
4 "VOTED to rescind the instructions to AIEE representatives on the EJC Board of Directors to work for the development of EJC into an individual membership type of unity organization."

Modifications

The functional modifications referred to in action 1 provided that EJC would relinquish the activities it was then conducting in the fields of employment conditions, labor legislation, practice of engineering (code), social security legislation, and certain kinds of special surveys (the more recently initiated activity in engineering education would likewise be considered inappropriate); that ECPD would relinquish its interest in the practice of engineering (code); and that NSPE would relinquish its activities in the fields of technical education and young engineers.

Engineers Joint Council would function primarily as a co-ordinating body for technical matters crossing the boundaries of the various disciplines. It would retain its interest in the recognition of specialties, honors for engineers, the National Engineers Register, and relations with corresponding bodies in foreign countries. This is the "technical" group of activities.

Engineers' Council for Professional Development would continue its interest in the education and development of young engineers, the establishment of standards for engineering education, the accreditation of engineering curricula, and the Canons of Ethics. This is the "educational" group of activities.

National Society of Professional Engineers would continue its activities relating to registration of engineers and economic considerations in the employment of engineers, including salaries and fees. It alone would be responsible for formulating rules of behavior under the ECPD Canons of Ethics and for discipline under these rules. It would continue its activities in national affairs and national defense and would be the sole spokesman for the profession in matters of legislation affecting engineers. It would be responsible for public relations to enhance the prestige and standing of the engineering profession as a whole. (The technical societies would, of course, be free to conduct such public relations activities as they consider appropriate in their own specific fields.) The activities allocated to NSPE are those in the "professional" group.

With regard to surveys of the profession, it was the consensus that when the subject matter is technical, surveys by EJC or a similar technical co-ordinating body are proper. When the subject to be surveyed is political or has to do with economic welfare and working conditions of engineers, it was considered to be more properly the function of a body of the type of NSPE.

No Change in AIEE

It will be noted that the subject under consideration by the Board of Directors, and upon which it acted, related to the functioning of EJC, ECPD, and NSPE. There was no proposal that AIEE should discontinue any of its interests or activities or any of the services which it customarily has been giving to its members, including students. EJC and ECPD are joint agencies established by the individual membership engineering societies to carry out jointly on behalf of the members of those societies certain functions which are of broad interest to the entire profession and which can be more effectively handled in this manner. AIEE, in working through such joint agencies, does not relinquish any of its interest in or responsibility for the subject matter. Such joint agencies are composed of representatives of the various societies acting for the societies they represent, not independently of them.

Because of the variation in conditions affecting engineers in the various disciplines, it is contemplated that the engineering societies will continue to maintain committees on such matters as education, registration, professional conduct, etc., for liaison with EJC, ECPD, or NSPE, as the case may be, to insure that those groups are kept informed as to the particular viewpoints of the members of the various societies.

There can be no question but that AIEE will continue to need an Education Committee, for example, to keep alert and up to date on problems and needs in electrical engineering education, in order to interpret these to ECPD and assist ECPD in the establishment of policies and criteria pertaining thereto. In the field of any

learned profession, there is no person or group of persons qualified to establish standards of education, competence to practice, ethics, etc., except the members of that profession. It is, therefore, the responsibility of the organization of the members of that profession to concern itself with these matters. AIEE is the organization of the members of the profession of electrical engineering, and, therefore, *is* the profession of electrical engineering. Its responsibility is inescapable. The fact that certain of its members who are engaged in the education of electrical engineering students may be members of certain committees of ECPD or members of the American Society for Engineering Education (ASEE), or both, is a mere coincidence. The responsibility for standards of education in the field of electrical engineering rests with the profession as a whole. It is appropriate and convenient that it join forces with other branches of the engineering profession in setting up a joint agency for efficiently carrying out its responsibility, under guidance; but this does not relieve it of the responsibility.

The special committee provided for in action 2 of the Board was appointed. It prepared a statement which, after study and revision by the Board, appeared in the form of the letter referred to previously.

It will be noted that action 3 provided for a *suggestion* to be made to NSPE and did not impose this as a condition related to action 1. During subsequent meetings of the Board of Directors, it was decided that if NSPE would accept this suggestion, the AIEE Board would urge all of its members to affiliate with NSPE. This appears in the letter to the membership.

Action 4 related to long-standing instructions to our representatives on the board of directors of EJC. When the proposal to enlarge EJC was adopted by the engineering societies as a result of the work of the exploratory group on unity of the profession, AIEE imposed upon EJC the obligation to give prompt consideration to converting itself from a joint body of representatives to an individual membership organization. This was considered by EJC, but the decision was in the negative. Under the functional plan for division of activities among EJC, ECPD, and NSPE, there would be no advantage in making EJC an individual membership organization.

Registration

The success of the functional plan and the strength of the organized profession obviously will be greater as more and more engineers who are members of a technical society also join NSPE. AIEE has, for many years, recommended to its members that they take steps to register as professional engineers. The Board of Directors believes that this is an essential step in the full development of the practicing engineer, whether he be a consultant or employed in industry. We urge all young engineers to register in their states as early in their careers as possible. If this advice is followed by members of all the technical societies, it is obvious that the time will come when the same people who make up those societies will be the members of NSPE or at least eligible for membership in NSPE. It is believed that NSPE can put itself immediately in a much stronger position to carry out the responsibilities proposed for it by the functional plan if, for a period of years, it will open its membership to nonregistered engineers who are otherwise qualified as evidenced by their holding suitable grades of membership in technical societies which subscribe to ECPD uniform membership grade standards.

This is the reason for making this *suggestion* to NSPE as an interim measure and offering, if it is accepted, to urge all of our members, both registered and nonregistered, to join NSPE.

One Society

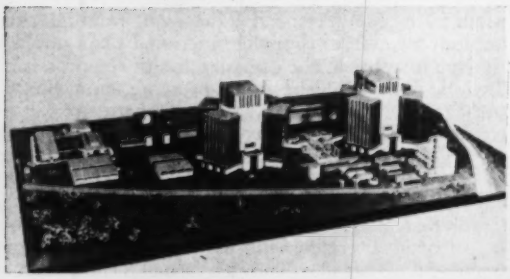
If, eventually, it appears desirable to amalgamate all of the various societies into one unity organization for engineers, AIEE believes that the adoption of the functional plan will facilitate this end. AIEE is not at this time taking a stand for or against such eventual amalgamation. However, even without such eventual amalgamation, we believe that the functional plan would be a big step forward in the organization of the profession, and would permit, indeed would promote, more effective performance. It is recognized that there are certain practical obstacles in the way of establishing an over-all unity organization at the present time. To mention but one: The American Medical Association and the American Bar Association are classified by the Director of Internal Revenue under paragraph 501(c)6. Undoubtedly, an over-all engineering unity organization would be similarly classified. The individual membership engineering societies today, other than NSPE, are classified under paragraph 501(c)3. These societies are embarked upon a plan for raising funds for the erection of a new $10-million United Engineering Center fronting on United Nations Plaza in New York City. Contributions to organizations classified 501(c)3 are deductible to the donor for tax purposes; contributions to organizations classified in 501(c)6 are not.

If we could have the clear-cut nonconflicting functional organization contemplated in San Francisco and if, in addition, all the eligible members of the technical societies were also members of NSPE, we would have an organization of the profession which would indeed be strong. Certain of the other engineering societies have been favorably impressed by the functional plan and have taken steps to call it to the attention of their members. It is to be hoped that the other societies will take parallel action and that the plan may receive the positive endorsement of all groups.

Just before this article was sent to the editor, it was learned that the Council of The American Society of Mechanical Engineers (ASME), meeting on November 30, 1957, approved the recommendation of their Organization Committee ". . . that ASME endorse the 'AIEE plan,' as outlined in M. S. Coover's March 18, 1957, letter to President Ryan." The Council also indicated its willingness to explore the plan with the organizations involved. This is indeed good news. It is most heartening to find ASME and AIEE, two of the largest segments of the engineering profession, in agreement regarding what seems to be the most constructive proposal yet advanced for straightening out the somewhat tangled organization of the profession.

Illustrative of the need for clarification are the actions of AIEE and some other societies in approving the proposed affiliation of NSPE with ECPD, and the recommendations by certain societies that NSPE join EJC. These relationships were not contemplated by the AIEE Board at San Francisco and would seem to be inconsistent with the proposed separation of the fields of interest.

NUCLEAR POWER IN BRITAIN



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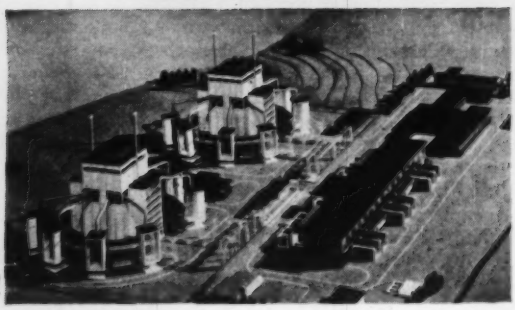
A program of nuclear power intended to take over a major part of the electricity production in Britain provides for 12 nuclear power plants by 1965



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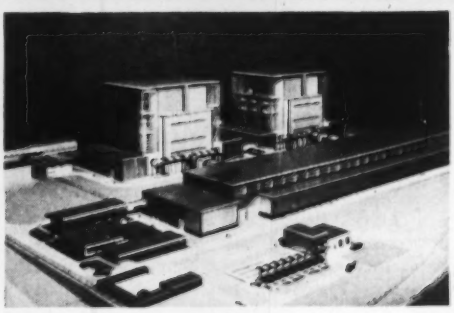

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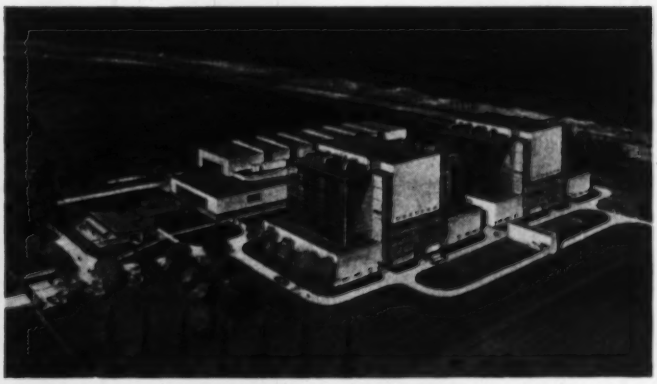


4

1 Model of the 360,000-kw GEC–Simon Carves Atomic Energy Group for Hunterston, Ayrshire, South Scotland. 2 Model of the AEI–John Thompson Nuclear Energy Company, Limited, for the 275,000-kw plant, under construction at Berkeley, Gloucestershire, also scheduled for operation in 1961. 3 The $168-million Hinkley Point, Somersetshire, plant will have 500,000-kw electrical output, although roughly the same size as its predecessors at Berkeley and Bradwell. The two graphite-moderated gas-cooled natural-uranium reactors are expected to produce power at a cost below the national average of 0.65 pence, about 7.6 mills. 4 The Nuclear Power Plant Company Limited design for the 300,000-kw station at Bradwell, Essex, has the same type of gas-cooled graphite-moderated nuclear reactor as Berkeley. It is under construction and scheduled for operation in 1961.

By W. R. Wootton

Assistant Manager, Atomic Energy Department, Babcock & Wilcox, Limited, London, England

THE electrical supply industry in Britain has generating capacity aggregating about 20,000,000 kw for a population of 55 million. The annual coal consumption of the industry is 40 million tons and the sale of electricity is about 70,000 million units. Estimates of the requirements by 1975 are 100 million tons of coal and 200,000 million units. Despite large capital investment in the

Contributed by the Power Division and presented at the Semi-Annual Meeting, San Francisco, Calif., June 9–13, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from Paper No. 57—SA-57.

coal mines, it cannot be foreseen that more than 60 or 70 million tons of coal will be available to the industry by then and hence the steps which have been taken to bridge the gap, at least partially, by the installation of new plant, and conversion of some of the old, to burn oil to the extent of some 10 million tons yearly. The remaining deficit it is intended to rectify by the bold application of nuclear energy.

The gas-cooled graphite-moderated stations would provide the industrial experience and the plutonium needed for the much greater expansion between 1965 and 1975. The Government White Paper published in February, 1955, suggested that it might be possible in the early 1970's to build nothing but nuclear stations to meet the additional demands of the electricity supply industries.

Britain's atomic development facilities, established during the War, expanded rapidly, and it was not long before reactors of the gas-cooled graphite-moderated type were built both at Harwell and Windscale. The reactors at Harwell were built for research purposes and the production of radioactive isotopes on a commercial basis. Those in the North were built for the production of plutonium for military purposes. Associated with these projects were plants for fuel-element fabrication, diffusion separation, and plutonium extraction, all in the north of England.

Atomic Energy Authority

In 1954, a few months after the start of construction of Calder Hall, responsibility for work on atomic energy, first carried out by the Department of Scientific and Industrial Research and later shifted to the Ministry of Supply, was again transferred, this time to the Office of the Lord President of the Council.

The Atomic Energy Authority was created in a form outside the normal framework of an ordinary government department. It is a nationalized undertaking, depending for its funds upon money voted by Parliament. To achieve flexibility and speed of decision, the organization is run on industrial lines, and with no responsibility outside the field of atomic energy. The Lord President intervenes only if over-riding national interests so require. Expenditure for the current year is estimated at $196 million and the staff numbers 25,000.

In the field of nuclear power, the Atomic Energy Authority invites appropriate industrial participation even in the earliest phases of development of a reactor system. A fully co-operative effort develops between the Authority and the industrial firms concerned, each firm contributing to the design in the specific field in which its experience lies. Substantial technical contributions are made by the Authority in many aspects of the design. There is no assurance that industrial participants who contribute to the project in the early stages will be those who eventually are awarded construction contracts. Invariably, such participation is through the medium of a Development Contract with an agreed ceiling expenditure to cover the cost of design, draftsmanship, research, and so on. Patentable ideas which are the outcome of such collaboration are the property of the Authority who will, however, license the interested industrial participant on a nonexclusive, royalty-free basis, reserving the right to license others similarly.

The conclusion of a particular collaboration carried out either at Harwell or Risley might be the recommendation that a specific reactor system should be implemented by prototype construction. The final choice of industrial participants, and the placing of orders, is done at Risley, where a Design Office devoted entirely to the specific project would be established to co-ordinate the detailed design and construction of the plant.

The development of reactor systems is, of course, only a small fraction of the part played by the Authority in the nuclear power program. The design and manufacture of fuel elements, the supply of fuel for the installed power reactors, and the design and construction of reprocessing plants for irradiated fuel are among many other activities in this field. Responsibility for generation and transmission of electricity, however, rests with the Central Electricity Authority, the South of Scotland Electricity Board, and the North of Scotland Hydro Electric Board.

Although the White Paper of February, 1955, proposed that there should be between 1,500,000 and 2,000,000 kw of nuclear plant in commission by 1965, before the close of that year the general feeling was that this should be doubled. Now it is suggested that the figures should be trebled or even quadrupled.

Calder Hall

When the British Atomic Energy Organization was set up in 1946, the intention was to build water-cooled, graphite-moderated reactors of the original Hanford type. Considerations of safety, however, resulted in attention being turned toward reactors of the gas-cooled, graphite-moderated type which were inherently stable. It was realized that gas would be much more effective if it were possible to put the whole system under pressure and utilize extended-surface fuel elements, but because of the limited time available the early Windscale reactors for the production of plutonium were cooled at atmospheric pressure.

By the end of 1953 it became evident that, as foreseen in 1950, reactors of the gas-cooled graphite-moderated type, reoptimized for power, could be used as a basis for a major development of nuclear power in Great Britain. The plutonium produced as a by-product could be used as a fuel in other reactors, although it might be necessary to develop liquid-cooled reactors of higher rating to burn it satisfactorily. A scheme setting out a long-term plan to this end was prepared and formed the basis of the Government White Paper already referred to.

Gas-cooled graphite-moderated reactors are heavy, cumbersome, and expensive, but they are inherently safe; they use natural uranium as a fuel, and their construction makes use of orthodox materials and techniques. They can produce power at a cost comparable with that of a modern station using conventional fuel. They are capable of development as experience with fuel elements grows, modest advances in temperature being associated with appreciable improvements in thermal efficiency and capital cost.

Technical Considerations

Chemical compatibility under irradiation[6] of all materials within the reactor core was a primary design requirement. Magnesium was used for canning since no chemical reaction occurs between it and uranium, even under irradiation. Magnesium alloys containing

beryllium and certain other elements have also given encouraging results in so far as compatibility of coolant and canning materials is concerned, there being no measurable attack up to 600 C in wet air, the most generally corrosive environment. At one time it was predicted that the reaction between carbon dioxide and graphite would make it impossible to use this as a coolant. Intensive experimentation has shown that only a very slow mass transfer of graphite from one part of the core to another would take place.

Experimental programs were also undertaken to achieve the greatest possible heat release from the fuel at a given temperature and with an economical power expenditure in the coolant circulators. The outcome of this was the evolution of transverse finned elements optimized in diameter, fin pitch, and thickness.

Center-channel heat outputs around 160 kw were made possible without the fuel elements exceeding 400 C. The gas temperature could approach to within 60 C of this temperature, allowing steam generation at around 600 F.

Core Design. A vertical-axis design was adopted for the core mainly because the problems of support and restraint of the large mass of graphite were simplified.

Fuel elements are stacked one on top of the other and the reactor charged and discharged from the top.

Steam Generator. Dual-pressure steam generation was adopted at Calder Hall for two reasons: For a plant of this type, optimized for electrical power, it showed an increase in output of between 10 and 15 per cent in comparison with the single-pressure cycle; for a plant optimized with the emphasis on plutonium production, as Calder Hall is, it showed an increase in output even greater than this. In the feasibility study stage of the project, when the plant was optimized for electrical power, it was designed to have an electrical ouptut of 35,000 kw from a reactor thermal output of 144,000 kw, an over-all thermal efficiency of 24.5 per cent. As constructed, it has an electrical output of 39,000 kw from a reactor thermal output of 182,000 kw, an over-all thermal efficiency of 21.5 per cent. It is for this reason that the cost of electricity produced in the plant is meaningless if attempts are made to compare it with nuclear power plants optimized for electrical power. The Calder Hall steam-raising plant is designed to produce steam at 210 and 63 psi in the ratio 77:23.

Operating Experience. A great deal of operational experience has already been accumulated at Calder Hall. One outstanding fact is the trouble-free manner in which the plant has been brought into continuous operation. Initially, the coolant temperature at the reactor outlet was lower than design, as a result of better nuclear performance than predicted; in other words, the reactor "went critical" earlier than was anticipated. This in turn disturbed the relation between coolant and thermal-neutron distribution, necessitating the temporary acceptance of lower bulk temperatures until the distribution could be corrected by appropriate introduction of the absorber into the core.

The plant has been shut down on two occasions as a result of automatic detection of faulty fuel elements. So sensitive is this equipment, that it is practically impossible to locate the faults in subsequent examination. Another unexpected development is the loss of about 1 ton daily of coolant; but carbon dioxide is abundant and cheap. The leakage has been traced to wisps of gas escaping at a number of points associated with minor coolant pipe work which can undoubtedly be remedied.

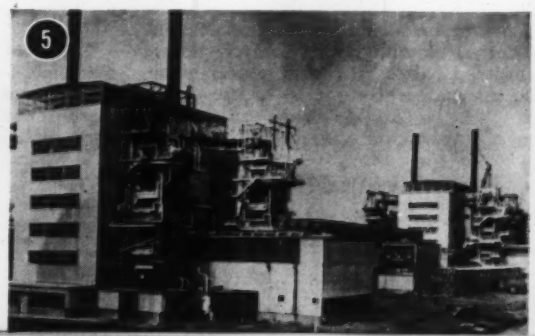
Construction of two more nuclear power stations is in an advanced stage at Chapelcross, in the south of Scotland. The combined output of these, like that of the two stations at Calder Hall, will be 160,000 kw.

Industry Participation

Early in 1955, the Authority asked four of the largest manufacturers of electrical plant to form individual groups with a view to competing for two nuclear power stations, to be built as the forerunners of the 12 referred to in the Government's 1955 Program. Reduction in the capital cost of nuclear plants was another objective. Each group would comprise mechanical and civil-engineering contractors with a minimum number of Atomic Energy Authority personnel for guidance. Each group was constituted to undertake the design and construction of complete nuclear power stations, a factor of particular importance in relation to the export market.

There was some hesitancy in the discussions, however, because of the competition among the companies and reluctance to disclose new developments. One very positive outcome of the competition was the early rejection of the idea of conservative development of the Calder Hall plant, groups vying with one another to be a step ahead. Industry took the bold step of multiplying the thermal output of the reactor by a factor of three, and the electrical output by a factor of four. To achieve this meant increasing the diameter of the core of the reactor by 50 per cent and raising the coolant pressure a similar amount. Each station comprised two reactors and was designed for a net electrical output of 250 to 300 mw.

Two design policies offer themselves in the development of gas-cooled, graphite-moderated nuclear power plant: The first aims for the highest efficiency, expressed as the ratio of net electrical output to nuclear thermal output. The purpose of this is not so much to minimize the running cost of the stations by keeping the consumption of fuel to a minimum, but to spread the high capital cost over the maximum possible output. The second aims to raise the thermal output of the reactor itself as much as possible by increasing the coolant flow and, in turn, the blower-power consumption. The inducement to take this step is in the high fraction of capital cost which lies in the reactor area. The result of this approach is a cheaper station but of lower efficiency, the latter being due to the higher blower-power consump-



5 General view of the Calder Hall "A" Power Station. 6 The turbine hall of Calder Hall "A" Power Station. 7 Can-failure-detection pipework in Number 1 Reactor at Calder Hall. 8 Test rig for fuel-element cans under simulated conditions of the gas-cooled reactor.

tion. Since annual charges on capital investment are considerably higher than fuel replacement charges, the cost of production of electricity could be the same as in the more efficient, more expensive plant.

None of the industrial groups embarked on any radical departure from the vertical channel arrangement of the Calder Hall reactor. Three, however, departed from the cylindrical pressure vessel and offered spherical ones, up to 70 ft in diam and 3 in. thick. All retained the vertical column arrangement of heat exchanger, filled with multiloop extended heating surface with the coolant in crossflow outside the tubes. All, again, retained the dual-pressure steam cycle, but the range of upper steam pressures offered varied between 300 psi and 750 psi, with temperatures varying between 600 and 700 F.

Developments in maximum permissible fuel-element temperature were made as a result of intensive experimental work during the period when bids were being submitted. Temperatures up to 50 C higher than that at Calder Hall were offered, contributing appreciably to the over-all efficiencies of 28 to 29 per cent. Radical departures in shape of extended heating surface of some of the fuel elements resulted in improved heat transfer and saving in blower power. Considerable improvements in fuel-element handling techniques were also effected, enabling the elements to be changed under load.

Cost Estimates. The cost of each station was between $98 million and $112 million and the anticipated cost of production of electricity was around 8 mills per kwhr. Three of the stations are for the Central Electricity Authority, and one is for the South of Scotland Electricity Board.

Prospects of the Calder Type Reactor

The industrial groups found no limitation to the size of an individual gas-cooled, graphite-moderated reactor, at least not within the bracket of what could be considered an acceptable size in Britain. It must be recalled that only recently have conventional coal-fired power stations been commissioned with unit boiler-turbine plants of 100,000 kw while the first of the 200,000 kw conventional units will not be commissioned until 1959. Yet the groups offered, for the first nuclear power plants, units of 150,000 kw. There appears to be no reason why this should not be doubled.

Increase in size is one way of reducing capital cost; but a more important way is to improve thermal efficiency. A gas-cooled, graphite-moderated nuclear power plant is particularly responsive to increase in thermal efficiency arising from improvements in coolant temperature. This is the outcome of the manner in which attainable steam pressures, as well as temperatures, are tied to available coolant temperatures. For instance, if the latter were to rise to 1000 F, which is quite probable, a supercritical-pressure reheating steam cycle becomes a possibility, contributing to an over-all thermal efficiency of 40 per cent or more. As the diameter of the core of a reactor of the Calder Hall type increases, it becomes necessary to "flatten" the flux distribution by addition of an absorber in the central region to avoid overheating there. It is likely, for instance, that the operating temperature may be raised by the adoption of certain alloys of uranium stabilized in the gamma phase, the alloying diluents being acceptable because of the need for an absorber. It is equally likely that fuel elements having larger surface-to-mass ratios, perhaps clad with a metal of high melting point, will come into use. Uranium carbide fuel-cum-moderator is another possibility.

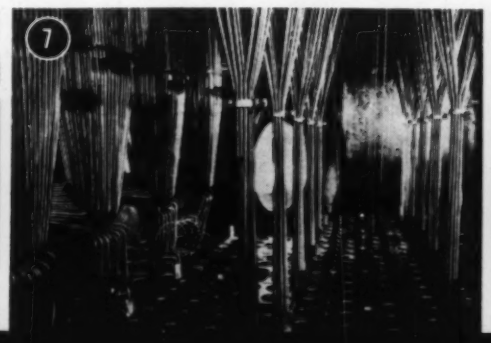
Possibility of Smaller Units. Among other prospects of the Calder Hall type of reactor is its applicability for smaller units. If the Calder Hall plant were reoptimized for electrical power, and were to be built again today, with fullest advantage being taken of the know-how acquired there, it would produce electricity at a little over a cent per unit, no value being attributed to the residual plutonium. If coolant pressure were raised, capital cost per kw of electricity would be appreciably below a penny per unit. Such a plant would fall in the category of 30,000-kw unit reactor-turbine combinations, a size with wide application throughout the world.

Future Program

In a large integrated program of nuclear power, the development of the gas-cooled, graphite-moderated reactor is closely associated with that of the fast reactor operating on a plutonium-uranium cycle and also producing power. Developments at Calder Hall should be regarded in the light of those at Dounreay, in the north of Scotland, where an experimental fast reactor is currently under construction.

On the basis of the Government's program of nuclear power, it is apparent that, by the early 1960's, by-product plutonium will be produced in substantial quantities. This will enable an expanding network of breeder reactors to be constructed, and bring at the same time the fertile metal thorium into the pool of available nuclear fuels. Problems associated with the fabrication of fuel elements from radioactive plutonium are severe, but an intensive program of development is currently being undertaken and a solution is confidently anticipated. Plutonium fuel elements already have been made on a small scale and used in research reactors of the fast-neutron type. In addition to the developments at Dounreay, other types of reactors designed to use plutonium are being considered by the Atomic Energy Authority. Among these are advanced types of the gas-cooled reactor, the sodium-graphite reactor, and the high-temperature gas-cooled reactor.

The authoritative opinion has been expressed that plants of the Calder Hall type of reactor will still be built 25 years from now. It is by no means a stop-gap adopted by a country with a fuel shortage.



Axial-Flow Exhaust Turbine and Monotube Boiler Are Basic Design Considerations of

PORTLAND GENERATING STATION

By J. G. Miller[1] and R. H. Kreisinger[2]

PORTLAND STATION is another step in the continuous improvement in over-all efficiency in both production and maintenance, and an ever-increasing use of automation in the operation of U. S. power stations. The highest initial steam condition justifiable for the size of the unit was used. The location of the power plant will be on the Delaware River near Portland, Pa., 5 miles downstream from Delaware Water Gap. Circulating water is available to support at least 1000 mw, and the plant is designed for ultimate installation of at least six units. The capacity of the first unit will be approximately 165 mw, allowing for 10 per cent overload above the manufacturer's maximum rated capacity of 150 mw. The plant arrangement is sufficiently flexible to accommodate larger units on the upstream side as system growth may warrant. The station is basically a semi-outdoor design with the turbine, generator, and auxiliaries, and front and lower part of the steam generator indoors, Fig. 1.

Steam Conditions and Cycle

The temperature was limited to 1050 F to avoid using austenitic-steel piping. Initially, 3500 psi was considered, but the size was too small to justify this pressure. The final choice was 2400-psi nominal pressure, 1050 F initial temperature, and 1050 F reheat temperature. The 1050 F reheat temperature over 1000 F appears to be a break-even proposition at today's fuel cost, and the

[1] Metropolitan Edison Company, Reading, Pa. Mem. ASME.
[2] Gilbert Associates, Inc., Reading, Pa. Mem. ASME.
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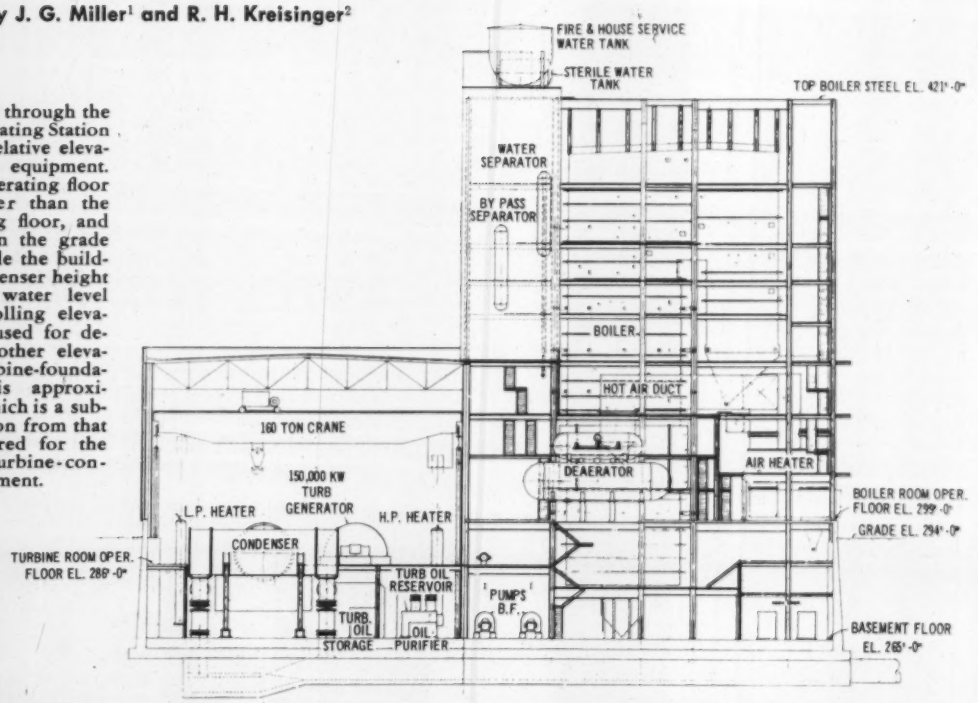


Fig. 1 Section through the Portland Generating Station showing the relative elevation of major equipment. The turbine-operating floor is 13 ft lower than the boiler-operating floor, and 8 ft lower than the grade elevation outside the building. The condenser height above normal water level was the controlling elevation and was used for determining all other elevations. The turbine-foundation height is approximately 21 ft, which is a substantial reduction from that normally required for the conventional turbine-condenser arrangement.

higher temperature was chosen in the interest of achieving a lower heat rate and anticipated long-range economic advantage. The nominal operating pressure of 2400 psi will be maintained until turbine-inlet valves are wide open, at which time the controls will be reset to increase to and maintain an operating pressure of 2520 psi in order to get additional capacity from the unit. The cycle is slightly more efficient at 2400 psi, which is the reason for holding the lower pressure level to the limit of the inlet valves.

Seven stages of feed heating are provided in the cycle, Fig. 2, with a drain cooler above the highest pressure heater for cooling drains from the water separator in the steam-generator circuit before they are returned to the feedwater circuit. The use of this drain cooler reduces the flashing head of water entering the top heater, and this results in both a lower cost heater and a slightly improved cycle efficiency. Deaeration is provided in both the condenser hotwell and the deaerating heater. The latter is unusual in that, at full load, the heater operating pressure is higher than customary for deaerator service, 165 psi. The savings effected by the elimination of one closed high-pressure heater more than offset the additional cost of the higher pressure deaerator. This arrangement also has other advantages, such as less probability of high-pressure-heater maintenance, and a wide range of unit loading with positive deaerator operating pressure.

The amount of the improvement effected in cycle efficiency by the use of an axial-flow exhaust turbine and side-entry condenser has yet to be determined in service. The Portland unit is the first large turbine built by the manufacturer which is designed to improve over-all heat rate by (*a*) reduction of the leaving loss with omission of customary 90-deg bend, and (*b*) reconversion of velocity energy in the steam, leaving the last-stage wheel to potential energy in the condenser. In other words, the absolute pressure at the exit of the last-stage wheel is expected to be lower than the absolute pressure in the condenser.

C-E Sulzer Steam Generator

When 3500-psi initial pressure was being considered, negotiations with Combustion Engineering, Inc., concerning the steam generator, developed considerable interest in the C-E Sulzer design (1, 2, and 3).[3] It appeared that this type of steam generating unit would become more commonly used in the future and that it offered certain features in starting that are becoming desirable as experience is gained with frequent shutdowns of high-temperature units. Metropolitan Edison Company and their consulting engineers decided that the C-E Sulzer unit offered advantages and had a place for subcritical pressure.

The steam-generating unit is conservatively designed to deliver 1,150,000 lb of steam per hr at 2610 psi, 1060 F superheat, and 1060 F reheat with a furnace heat release of 89,000 Btu per sq ft of effective projected radiant surface, Fig. 3.

The C-E Sulzer Monotube Steam Generator has several distinctive characteristics. There are no large heavy walled drums or downcomers; however, there are three pressure vessels—two water separators and a bypass separator. Since the location of these vessels is not restricted to any particular elevation, there was a space advantage in locating them near the top of the unit. The absence of heavy-walled pressure parts eliminates the

[3] Numbers in parentheses refer to the Bibliography at the end of the paper.

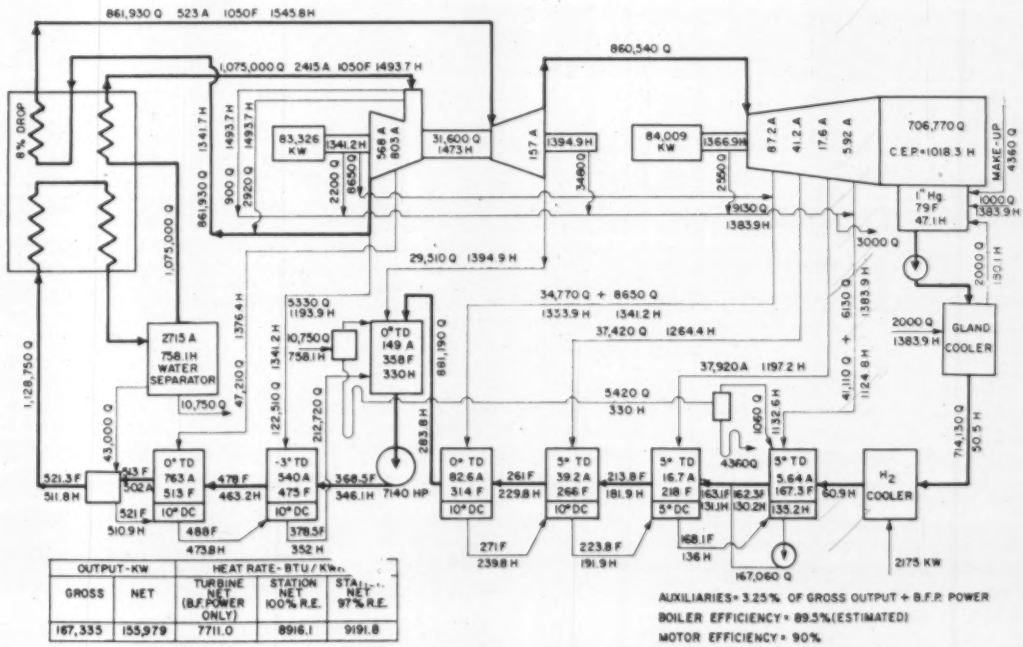


Fig. 2 Heat-balance diagram shows that seven stages of feed heating are provided in the cycle

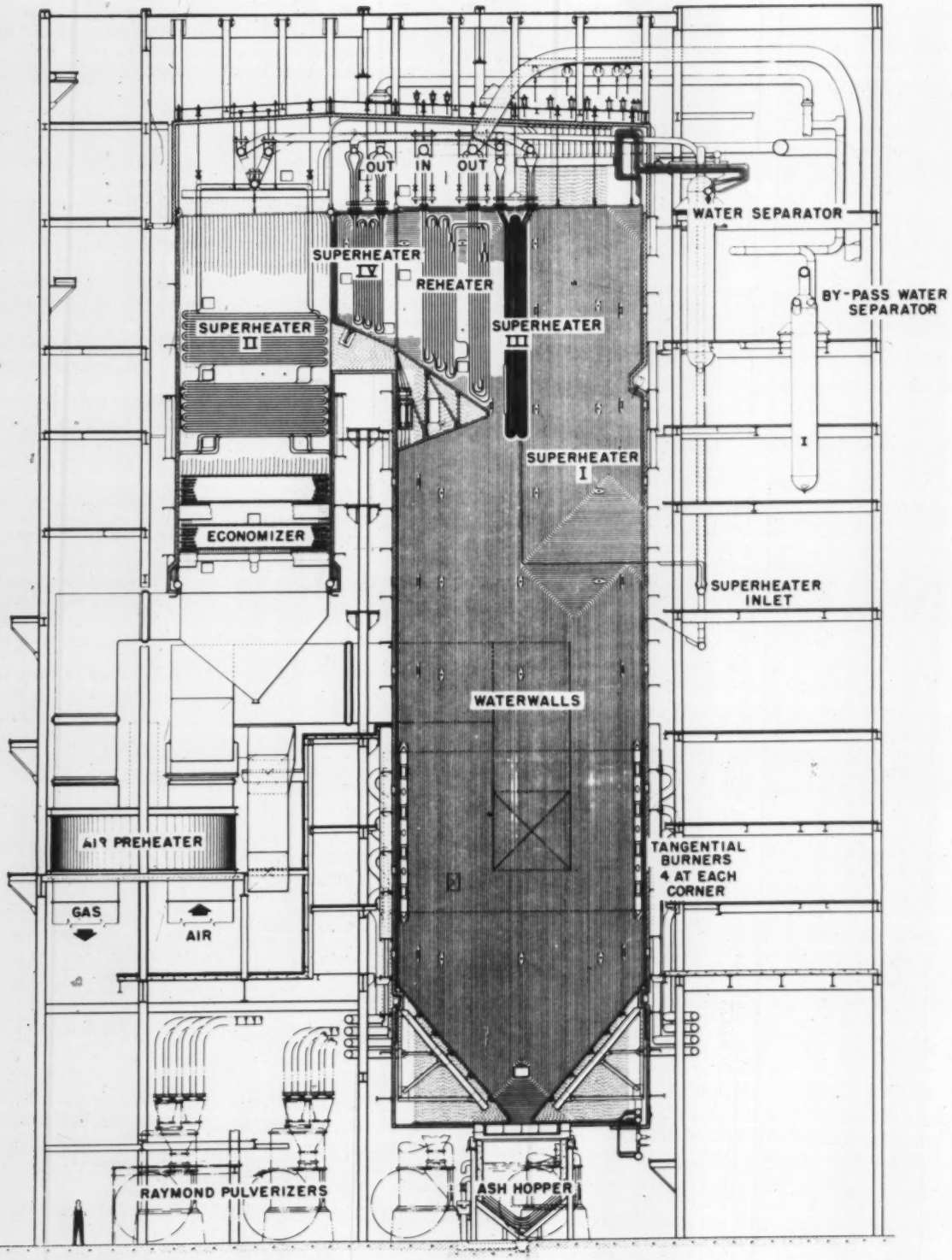


Fig. 3 The C-E Sulzer monotube boiler for Portland Generating Station Unit No. 1; capacity: 1,150,000 lb per hr at 2610 psi and 1060 F with reheat to 1060 F

problem of thermal stresses that restrict the operating flexibility of large conventional steam-generating units.

The water-and-steam side of the C-E Sulzer unit is divided into two halves that have separate controls. In the steam-generating section of the unit each half is divided into 6 circuits of nine $1^1/_2$-in-OD tubes each, with flow to the circuits controlled by a special sleeve-type throttling valve. Each half has its own water separator located between the evaporating section and the primary superheater. Solids are concentrated in the water separator, and approximately 4 per cent of the total flow is bled back into the cycle through a water-to-water heat exchanger shown in the heat-balance diagram, Fig. 2.

The water flow to the C-E Sulzer unit is controlled by two pressure-difference regulating valves and two flow-regulating valves. The flow-regulating valves take their impulse from one thermostat located on the outlet of the steam-generating tubes and from a steam-flow orifice located after the water separator. Any one tube in each circuit can be designated as a control tube since all tubes have a throttling valve at the inlet and a thermostat at the outlet. Only one tube in each circuit is used at a time for control, and the throttling valves are adjusted so as to give this tube steam with 50-deg superheat while the remainder of the generating tubes in the circuit produce steam with 4 per cent moisture.

Steam-temperature control is similar to that for conventional Combustion Engineering units with a combination of tilting burners and spray desuperheaters. Advantage is taken of radiant superheaters as shown in Fig. 3 to give a flat temperature control over a wide range of steam flow.

Another advantage of the C-E Sulzer type boiler is that it can be brought up to full pressure and the desired steam temperature in one hour or less. This feature is desirable in matching steam temperature to turbine-metal temperature for starting after a short shutdown, but has the disadvantage of requiring special controls, special valves, and unusual piping hookups that are not found in a conventional cycle. However, a bypass arrangement with a conventional unit to make possible matching temperatures on start-up is just as complicated and requires as many valves. The C-E Sulzer system provides for passing a minimum of approximately 30 per cent full flow through the evaporating section of the unit during start-up, and approximately 10 per cent to 30 per cent of full flow through the superheater and reheater is required to establish the desired steam temperatures.

Cross-Compound Axial-Flow Turbine[4]

Unit No. 1 at Portland is the first large close-coupled cross-compound axial-flow exhaust turbine, Fig. 4, purchased from the General Electric Company (4). The low-pressure turbine is a single-cylinder unit, and it has the same center line as the condenser. The turbine manufacturer has conducted a series of tests in conjunction with the condenser manufacturer to determine the shape of the turbine-condenser connecting piece for maximum recovery of velocity energy. The guaranteed heat rate makes allowances for the elimination of the 90-deg bend but not for the recovery of velocity energy, and tests will be conducted to determine the improvement.

[4] Some of the turbine details have been added from ASME Paper No. 57—PWR-6, "Design Features and Development of the Cross-Compound Single-Flow Turbine With Axial Exhaust."—Editor.

The cross-compound design presents several attractive possibilities in the arrangement of components for improved performance, and naturally leads to an opposed-flow, 3600-rpm, high-pressure, single-span unit, in a machine of moderate capacity, in combination with the 1800-rpm, low-pressure element. This type of unit design permits a station layout which offers the station designer new opportunities for reduction in station building costs.

The use of a single-flow, low-pressure element enables the turbine designer to incorporate an axial-discharge exhaust hood in which a significant portion of the kinetic energy in the exhaust can be recovered.

A plan view of the high and low-pressure turbine elements is shown in Fig. 4 The top view shows the opposed-flow-type, high-pressure turbine where 2400-psig 1050-F initial steam enters the mid-section through four control valves mounted on the shell, and then passes through four nozzle boxes and expands toward the generator through eight stages, and exhausts to the reheater at about 545 psig 670 F. The steam is reheated to 1050 F and, from the reheater, passes through the turbine-reheat stop valves and intercept valves and again enters the mid-section of the shell and expands toward the turbine front standard through five stages where it exhausts upward to a single 36-in. crossover.

The bottom view shows the low-pressure turbine where the steam enters the shell from the top crossover and expands through ten stages and the axial-exhaust hood to the condenser.

Side-Entry Condenser and Circulating-Water Supply

The choice of condenser design for use with the axial-flow exhaust turbine is most important if the expected improvement in cycle efficiency is to be achieved. Of necessity the condenser, designed and built by Ingersoll-Rand, is of side-entry type. It is single pass with divided water box, and has 80,000 sq ft of surface (5).

Condenser leakage cannot be tolerated because of the feedwater purity required by the C-E Sulzer steam generator. To minimize the possibility of leakage, the manufacturer is welding the tubes in tube sheet, utilizing a new process developed by Revere Copper and Brass Company. Tubes are admiralty metal and tube sheets silicon bronze, two readily weldable materials.

The condenser hotwell has capacity equal to 10 min full-load requirements or 14,000 gal, and is designed for maximum possible deaeration. Arrangements also are included for injection of steam from the bypass during start-up of the C-E Sulzer unit.

Combustion Control

Two basic methods are being provided for combustion control: (*a*) The direct-energy-balance method, and (*b*) the so-called conventional method. Selection may be made from one to the other by transfer switch, but it is expected that the direct-energy-balance method will normally be used. With the latter method, the input of fuel to the furnace is directly regulated by the unbalance between the required output and the actual generator output, Fig. 5, the air by generator output, and the turbine governor controlled to maintain steam pressure. The energy input to furnace is directly controlled to give the desired generator output, and the turbine keeps in step with the steam-generator output. The so-called

conventional method regulates the turbine governor to give required generator output while the energy input to the furnace is controlled to maintain steam pressure (6). Combustion rate anticipation is obtained from generator output plus regulation applied to turbine governor motor. With this arrangement the steam generator follows the turbine demand.

Coal-Handling

The basic idea in design of the coal-handling system shown in Fig. 6 was to provide minimum size bunkers and a large active storage outside with automatic control of the handling system to transfer coal by belt from active pile to the bunkers. Cars will be unloaded by a rotary dumper which will be equipped with scales for weighing incoming coal. From the car dumper hoppers, coal is transferred through a Bradford breaker to a traveling tripper and stacker to the active pile located over series of hoppers. The system to this point is controlled by unloading crew.

From active pile to bunkers, the system is under control of the operating crew in the station. Coal is fed onto a belt in the reclaim tunnel under the active storage pile by vibrating feeders, the number operating at any one time controlled by the operator in control room. For the ultimate station the system is planned as follows: When coal reaches the dividing hopper at the end of Unit 1 bunker, part is fed by a vibrating feeder to the belt supplying Unit 1 bunker, part by a vibrating feeder to Unit 2 bunker, and the remainder spills over to the belt leading to a dividing hopper at end of Unit 3 bunker. Here coal is again divided in same manner between Units 3 and 4 bunkers and the belt leading to Units 5 and 6. The amount of coal fed onto the belt to Unit 1 bunker is controlled by a belt scale which in turn controls its corresponding vibrating feeder. The belt scale is set to control at desired rate by control room operator. In the same manner, a controlled amount of coal is fed to all the other units. A summation of the set amounts on the individual bunker belt scales is transmitted to the scale on the main belt which in turn automatically controls the amount of coal being fed onto this belt by the vibrating feeders under active storage pile.

Each bunker is equipped with high and low-level controls and alarms. The latter are in the control room. Initially, with only one unit in service, the system will be operated intermittently to keep coal within high and low limits in bunker. After three units are in service, it is expected the system will run continuously.

Water Treatment and Control

In the modern high-pressure power plant, control of the feedwater in the cycle has become of critical importance. This is true even with the conventional steam generator with the large drum and comparatively large storage of water. For the monotube or once-through type of unit the feedwater condition is even more critical. The presence of oxygen cannot be tolerated in any high-pressure cycle, but in the monotube unit where the use of scavengers may be somewhat less effective than usual, deaeration is even more critical. For this reason, in addition to a deaerating heater, the condenser hotwell is of the reheat deaerating type with storage capacity equivalent to ten-minute flow at design condition and a maximum oxygen content in the condenser of 0.01 cc/liter.

The monotube boiler requires a high degree of feedwater purity and has, therefore, been the dominating factor governing the choice of feedwater treatment. This boiler can tolerate 0.5 ppm total solids. Since steam purity will not be significantly better than feedwater purity, the total solids will be limited to 0.25 ppm with 0.02 ppm max silica content to protect the turbine.

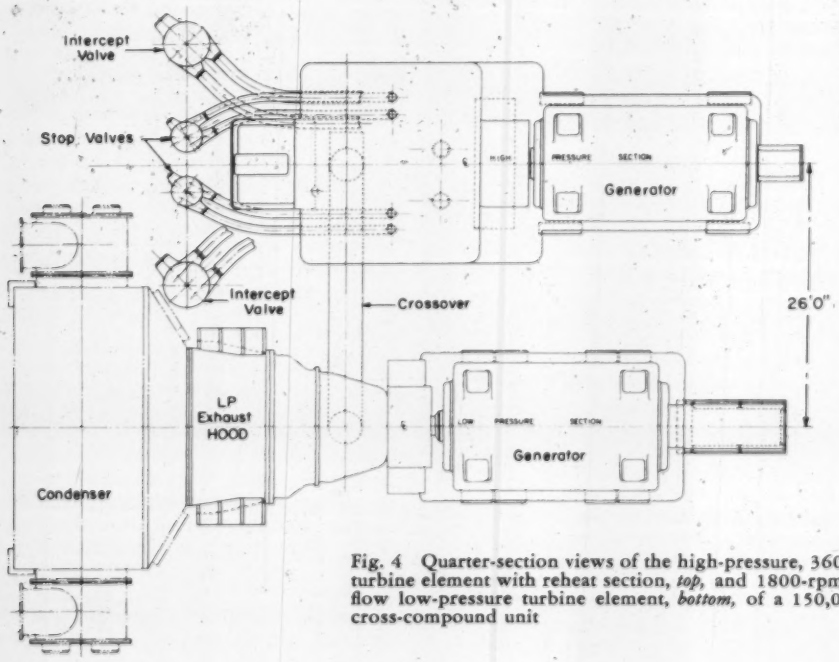


Fig. 4 Quarter-section views of the high-pressure, 3600-rpm turbine element with reheat section, *top*, and 1800-rpm axial-flow low-pressure turbine element, *bottom*, of a 150,000-kw cross-compound unit

In order to provide a condenser to meet these requirements, the tubes are welded to the tube sheets. The decision to use this construction was made after investigating and rejecting several other proposed methods for insuring a tight condenser.

Nearly all of the condenser manufacturers expressed confidence in their particular variety of rolled joint, but there was reluctance to accept this construction. In the first place, even those companies which report no trouble with condenser leakage, admit that the boilers must be blown down. This blowdown is necessary because of small amounts of condenser leakage that can be accepted with a conventional boiler, but could not be tolerated with a monotube boiler. In the second place, experience has demonstrated that some tubes which have been electronically rolled will work loose in the joint within a week after rolling. Double tube sheets were considered, but were found undesirable because of high cost and the possible trouble with differential expansion unless the adjacent sheets were widely spaced. The use of coatings, such as neoprene, while not rejected as a method of protecting tube ends and tube sheets, did not seem to offer as much assurance of a tight condenser as did the welded design.

Feedwater Treatment. Feedwater treatment will consist of hydrazine for oxygen scavenging and ammonia for pH control. Since little can be expected from hydrazine in the condensate-and-feedwater system, the dissolved oxygen must be kept low. The condenser will deaerate to 0.01 cc per liter, and the deaerating heater to 0.005 ppm—about the best deaeration that can be obtained commercially today. Morpholine is preferred for pH control because of its better distribution ratio, and consequently better turbine protection, but there has been little experience with morpholine in monotube boilers, and there is considerable concern with the products of decomposition which might result. As a result, the unit will be started with ammonia used for pH control.

Water-Treating Equipment. The requirement for make-up water containing total solids of the order of 0.1 ppm can only be met by double evaporation or demineralization, and the latter seems to be the more practical solution. The water-treating equipment is two 23 to 60-gpm demineralizer chains, each consisting of a cation unit, an anion unit, and a mixed polishing unit. A 180-gpm vacuum degasifier, common to both chains, is installed between the cation and anion units. All units are provided with semiautomatic regeneration.

Boiler Feedwater Pumps

Reliability of boiler feed pumps in service has been proved by experience in many installations, and because of this record only two half-size pumps are installed with Portland Unit 1 with provision for a third if Portland should prove exceptional. Estimated saving by elimination of the third pump is more than $200,000.

These Worthington pumps consist of an 1800-rpm booster pump directly connected to motor drive and a high-speed 6800-rpm pump driven through a hydraulic coupling and step-up gear (7). The use of the booster pump permits a much lower NPSH which in turn makes possible moderate saving by lowering of the required deaerating heater elevation. The high-speed pump was favored over the 3600-rpm pump because it is believed that the appreciably lesser number of stages and shorter and more rigid shaft will be more reliable.

Feedwater Heaters

As shown on Fig. 2, seven stages of extracting heating are provided with the No. 8 heat exchanger located above the high-pressure heater to serve as a drain cooler

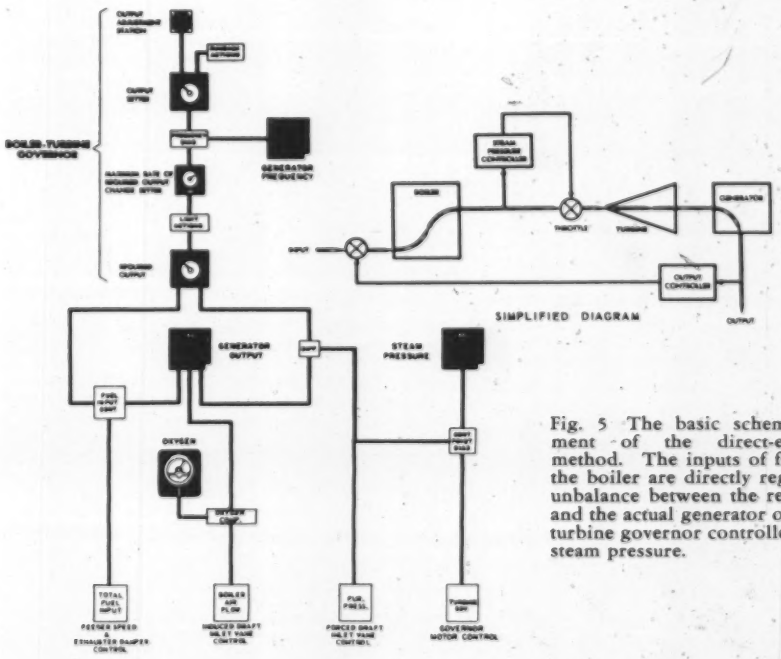


Fig. 5 The basic schematic arrangement of the direct-energy-balance method. The inputs of fuel and air to the boiler are directly regulated by the unbalance between the required output and the actual generator output, and the turbine governor controlled to maintain steam pressure.

for the drains from the water separator in the steam-generator circuit. Feedwater heaters Nos. 1, 2, 3, 4, 6, and 7 are vertical closed-type heat exchangers, and all except No. 1 have a drain-cooler section. The No. 8 high-pressure heat exchanger is horizontal type. These heat exchangers are all constructed with welded shell joints. The heads of heaters 6, 7, and 8 are seal welded, and the tubes are welded to the tube sheet. The high-pressure heater-tube material is monel metal. Admiralty tubes are used in the low-pressure heaters. All closed feedwater heaters and heat exchangers were manufactured by Griscom-Russell Company.

The No. 5 feedwater heater is a deaerating type, and is designed to operate under 165 psi max. This heater was purchased to give maximum deaeration, and is guaranteed to produce water with 0.005 ppm of oxygen. The deaerating heater was supplied by American Water Softener Company.

Electrical Data

Since the turbine is cross-compound, two generators are provided with Unit No. 1. The generator driven by the high-pressure turbine is designed for 3600 rpm, 102,000 kva, 0.85 pf, 13,800 volts; and the generator driven by low pressure for 1800 rpm, 100,000 kva, 0.85 pf, 13,800 volts. Excitation on both generators is 250 volts, and the rating is at 30 psig hydrogen. Excitation is provided by three motor-generator sets, two for normal operation, and one spare. Each set is rated at 300 kw, 250 volts, and operates at 1200 rpm.

The generator leads are directly connected by isolated-phase bus to the low-voltage terminals of a 3-phase transformer rated at 200,000 kva and 117/13.2 kv. The normal station-service transformer is rated at 15,000 kva, 13.2 kv/4160 v and is connected directly to the generator leads. The generators will be connected to system by 115 kv breaker located in the substation. Start-up and emergency auxiliary power supply are connected directly from the 115-kv bus in the substation through a 15,000/20,000-kva, 111 kv/4160-v transformer to the station-service bus.

In the station service-power system, all motors 150 hp or larger are 3-phase 4000-volts; from 1 to 125 hp are 3-phase 440-volt; all 3-phase fractional horsepower motors are 440-volt; and all single-phase fractional horsepower motors are 115-volt. The d-c power supply for the combustion control is by 125-volt battery which in turn is charged by diverter pole-changing set. A 125-kw diesel-generator set is provided for emergency power when the station is disconnected from the system.

Concluding Remarks

Even though the first unit at Portland includes (*a*) a monotube boiler, which is new in this country, (*b*) a new turbine design and a new turbine-condenser arrangement, and (*c*) a combustion control which involves a new concept, the total cost is not expected to be appreciably greater than for conventional design.

Initial start-up problems are not expected to be more complicated or more difficult than for conventional equipment, and commercial operation should be achieved within a reasonable time after the initial start-up.[5]

Bibliography

1 "The Monotube Once-Through Boiler for Conventional or Supercritical Pressures," by A. T. Hunter, *Proceedings, American Power Conference*, vol. 17, 1955, pp. 103–110.

2 "European Practice With Sulzer Monotube Steam Generators," by Jacques Gastpar, *Trans. ASME*, vol. 75, October, 1953, pp. 1345–1362.

3 "Engineering the Eddystone Steam Generator for 5000-Psig, 1200-F Steam," by E. M. Powell, *Trans. ASME*, vol. 79, August, 1957, pp. 1447–1457.

4 "Design Features and Development of the Cross-Compound Single-Flow Turbine With Axial Exhaust," by J. E. Fowler and C. Matney. ASME Paper No. 57—PWR-6.

5 Condenser at Portland, With Axial-Exhaust Turbine, Introduces New Horizons in Turbine-Condenser Operation," by G. T. Jones. ASME Paper No. 57—PWR-14.

6 "Unusual Features of the Portland Combustion-Control System," by E. D. Scutt. ASME Paper No. 57—PWR-8.

7 "Progress Report on High Speed Boiler Feed Pumps," by Igor I. Karassik and T. W. Edwards, presented at the American Power Conference, March 27–29, 1957.

[5] The design and construction of Portland station are not a one-man or one-company achievement. The co-operative efforts of the manufacturers, Gilbert Associates, Inc., and the Metropolitan Edison Company, have been essential to the carrying out of this project. It is appropriate, therefore, to express appreciation to all who have contributed and also to those who assisted in the preparation of this report.

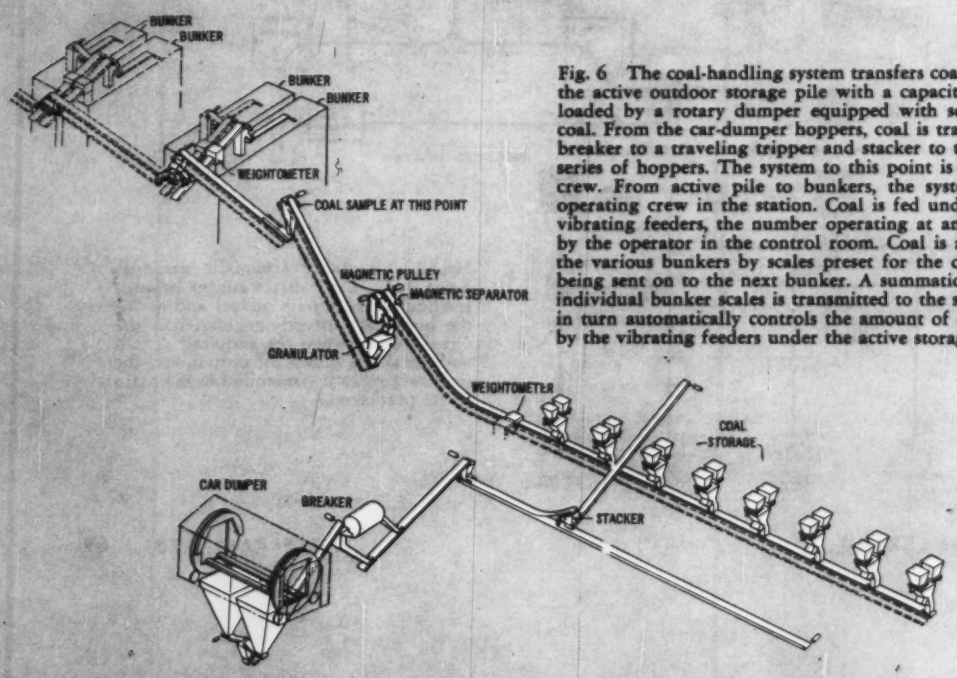


Fig. 6 The coal-handling system transfers coal to the bunkers by belt from the active outdoor storage pile with a capacity of 7000 tons. Cars are unloaded by a rotary dumper equipped with scales for weighing incoming coal. From the car-dumper hoppers, coal is transferred through a Bradford breaker to a traveling tripper and stacker to the active pile located over a series of hoppers. The system to this point is controlled by the unloading crew. From active pile to bunkers, the system is under control of the operating crew in the station. Coal is fed under the active storage pile by vibrating feeders, the number operating at any one time being controlled by the operator in the control room. Coal is automatically apportioned to the various bunkers by scales preset for the desired capacity, surplus coal being sent on to the next bunker. A summation of the set amounts on the individual bunker scales is transmitted to the scale on the main belt, which in turn automatically controls the amount of coal being fed onto this belt by the vibrating feeders under the active storage pile.

STRAIGHTENING VANES FOR FLOW MEASUREMENT

A new type of flow straightener, using separated plates, undergoes tests. The multiplate type has been designed to produce uniformly turbulent flow at an orifice or flow nozzle, making possible a new accuracy of flow measurement regardless of the geometry of the piping system.

By R. E. Sprenkle, Mem. ASME
and **N. S. Courtright,**
Bailey Meter Company, Cleveland, Ohio

THE measurement of fluid flow for acceptance tests and performance monitoring must be accurate to a fraction of one per cent. That is better than the present commercial limits. For such accuracy, the flow itself must be uniformly turbulent at the measuring point. If whirls, swirls, or other disturbances are present due to the geometry of the preceding piping, they must be eliminated before reaching the orifice, flow nozzle, or other type of primary element installed for metering purposes.

It is not always possible to produce a normally turbulent flow pattern by the use of conventional types of straightening vanes. First, each passageway, whether of the straight-tube or cross-plate form, is continuous throughout its length. While such vanes do break up the whirl or swirl into as many pieces as there are tubes or compartments, local swirls can still exist and be carried through, since the area of each compartment is still relatively large.

Also, most of the pressure loss through each of these passages is that caused by friction alone, which in these vanes is relatively low. This combination of local disturbances and low pressure loss can reduce flow-measurement accuracy below the required level.

A new flow straightener, the multiplate type, Fig. 1, has been devised to produce uniformly turbulent flow at the primary element (flowmeter). This consists of three plates in series, spaced about one diameter apart. Each plate has a large number of round holes arranged in symmetrical pattern.

As the flow stream enters the first plate, it is broken into small sections which tend to dissipate the helical motion of the swirl. Since the open area of the plate is about one half that of the pipe area, there is a considerable loss of pressure due to transfer of pressure energy into kinetic energy

Between the first and second plates, the flow sections intermingle. Thus some of the stratification which existed ahead of the vane is eliminated. The second plate repeats the function of the first, again subdividing the flow into many sections, creating a further breakdown of the swirl, and producing an additional pressure loss.

The intermingling is repeated in the second space, the small flow sections being reunited and slowed down; and then the third plate produces a third pressure loss. The much larger space between the last plate and the flowmeter completes the dissipation of the whirl and brings the flow to the primary element in a normally turbulent state.

The Trial Setup

Flow tests were first made in the Bailey Meter Company laboratory. To establish a standard to which the results of the vane tests could be compared, a 75 per cent Beta Ratio Concentric Orifice was first calibrated in a 4-in. straight pipe having at least 90 diam preceding it, and with 12 diam following (Section A, Fig. 2). Fig. 3 shows the calibration standard.

To produce disturbances, six 90-deg elbows at right angles to each other were introduced, supplemented by a disturber made of a plate with a number of segments turned at different angles (section B, Fig. 2). These disturbing elements produced errors in flow reading up to 29 per cent. Readings are shown by square points in Fig. 3.

As a further index of the magnitude of these turbulences, pitot-tube traverses were made in both vertical and horizontal planes at a point immediately following the disturber. Fig. 6 (middle view) shows velocity patterns across the pipe. It is believed that no piping arrangement in the inlet side would be likely to produce greater errors.

The Multiplate Flow Straightener

When the multiplate type was introduced, at a point after the disturber and eight diameters preceding the flowmeter, the disturbances were eliminated.

The evidence appears in Fig. 3, where the deviations of the check points (solid triangles) from the straight pipe standard do not exceed those of the standardizing points (circles) themselves. Pitot-tube traverses, made in horizontal and vertical planes two pipe diameters following the vane, are shown in the right-hand side of Fig. 6. Note how closely they approach the straight-pipe lines on the left.

Further, when the multiplate type was installed in the same straight pipe (without the bends and the disturber), there was less scatter of the calibration data than with ample straight pipe alone.

Similar tests were made with screens instead of plates. In this case, the openings were square instead of round.

Contributed by the Research Committee on Fluid Meters and presented at the Annual Meeting, New York, N. Y., December 1–6, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. ASME Paper No. 57—A-76.

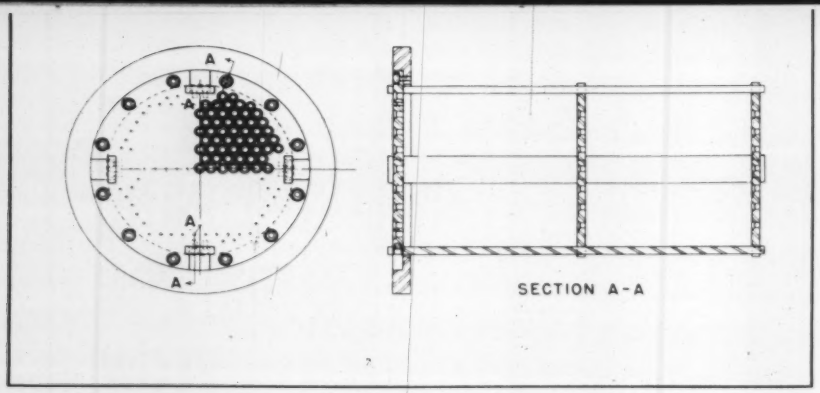


Fig. 1 The multiplate type of flow straightener, designed with three plates in series, spaced about one diameter apart. The holes break the flow stream into small sections, dissipating some of the swirl. With their total area about half that of the pipe, the holes cause a pressure drop. In the spaces between plates the flow sections merge, reducing stratification.

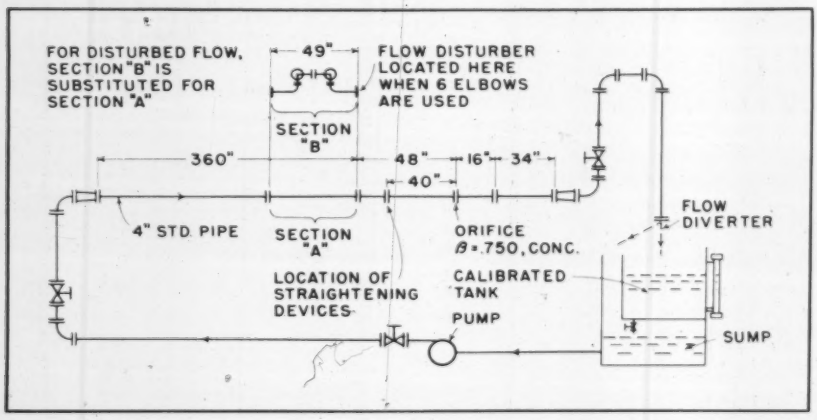


Fig. 2 Piping diagram of the Bailey Meter Company's test installation, which used 4-in. standard pipe. Straight pipe (A) was first used for calibrating the orifice. Then six 90-deg elbows at right angles to each other, supplemented by a disturber, were introduced (B) to provide maximum disturbance of the flow.

It was found that when the area of the openings through the multiscreen type approximated the area of the openings through the multiplate type, the straightening effect was practically the same. However, higher pressure losses resulted across the screens than across the plates.

In contrast, Fig. 4 shows the failure of a cross-plate type of vane to straighten out the disturbed flow generated in the same piping. Its points (solid squares) show considerable deviation from the standard, particularly at the higher velocities. This cross-plate vane had two vertical and two horizontal plates, 8 in. long.

A series of tests were also made using 41 small tubes, 8 in. long, and the results also appear in Fig. 4. Velocity profiles of both tubes and cross plates are indicated in Fig. 7. In neither case can the profiles compare with those produced by the multiplate type (Fig. 6) in the elimination of disturbances.

Fig. 5 shows the relationship between the pressure losses across the multiplate, multiscreen, multitube, and cross-plate types. It also shows the reduction in pressure loss which results from beveling the inlet edge of the holes in the multiplate type. The beveled inlet edge is just as effective in removing flow disturbances as the sharp inlet edge.

Although the Bailey Meter Company tests showed the multiplate type successful in eliminating serious flow disturbances in 4-in. pipelines, it was not assumed that it would be equally successful in larger lines. Questions needed to be answered concerning its proper proportions for larger sizes, and performance under higher velocities. It was also desired to have the results verified by a second laboratory, using different equipment, personnel, and operating procedure.

Arrangements were made with the Ohio State Experiment Station to repeat these tests on a 10-in. pipe size multiplate type. Prof. Charles Sepsy directed the experiments. A 75 per cent Beta Ratio Concentric Orifice was first calibrated in straight pipe to establish the standard, or reference, condition. Then the test installation, geometrically similar to that used in the earlier tests, was constructed, but with three elbows instead of six preceding the disturber on the inlet side, and only four diameters of straight pipe, instead of twelve, on the outlet side. The same type of disturber was installed.

The tests, performed with great care, confirmed the previous results. The calibrations showed even smaller deviations from the straight-pipe standard. Velocity profiles made at a point immediately following the flow disturber—and others following the multiplate straightener—showed shapes almost identical to those appearing at the right of Fig. 6.

It is concluded that the multiplate or multiscreen type of flow straightener effectively eliminates swirls, whirls, and other disturbances in the flow pattern, making it possible to obtain accurate flow measurements regardless of the geometry of the piping system preceding the flowmeter section.

Until sufficient operating experience has been obtained, it may be advisable that this flow straightener be installed in a by-pass line together with the primary element in order that possible accumulation of extraneous matter can be removed without shutting down the process.

STRAIGHTENING VANES FOR FLOW MEASUREMENT

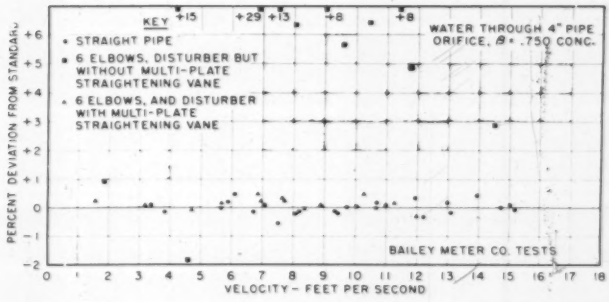


Fig. 3 The effect of the multiplate flow straightener on disturbed flow, compared with straight-pipe calibration and unstraightened flow. The straight horizontal line drawn through the circled points at zero ordinate represents the calibration standard which is unaffected by pipeline disturbances. Readings of highly disturbed flow are shown as square points.

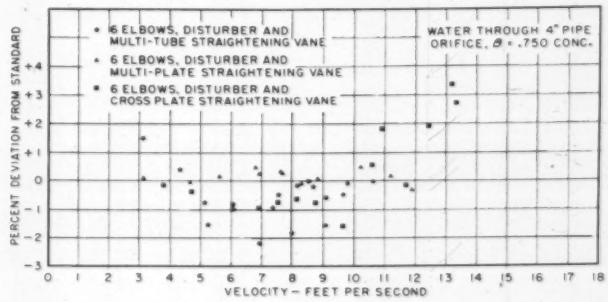

6 ELBOWS, DISTURBER AND MULTI-TUBE STRAIGHTENING VANE
6 ELBOWS, DISTURBER AND MULTI-PLATE STRAIGHTENING VANE
6 ELBOWS, DISTURBER AND CROSS PLATE STRAIGHTENING VANE
WATER THROUGH 4" PIPE ORIFICE, β = .750 CONC.
PERCENT DEVIATION FROM STANDARD
VELOCITY - FEET PER SECOND

Fig. 4 Tests of two other types, a cross-plate and a multitube design, are shown in comparison with the straight-pipe calibration. The pattern produced by the multiplate type is repeated (solid triangles) from Fig. 3.

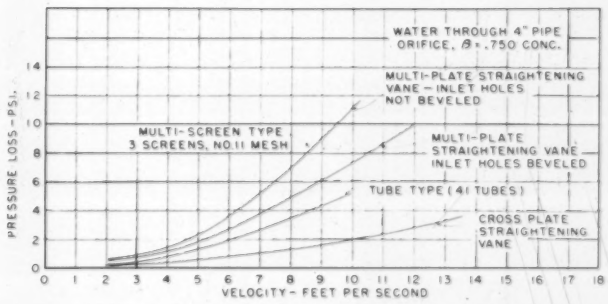

WATER THROUGH 4" PIPE ORIFICE, β = .750 CONC.
MULTI-PLATE STRAIGHTENING VANE - INLET HOLES NOT BEVELED
MULTI-SCREEN TYPE 3 SCREENS, NO.11 MESH
MULTI-PLATE STRAIGHTENING VANE - INLET HOLES BEVELED
TUBE TYPE (41 TUBES)
CROSS PLATE STRAIGHTENING VANE
PRESSURE LOSS - P.S.I.
VELOCITY - FEET PER SECOND

Fig. 5 Comparison of pressure losses across multiplate, multiscreen, multitube, and cross-plate types of straighteners. Whether the holes in the multiplate type were straight or beveled made no difference in its ability to remove flow disturbances.

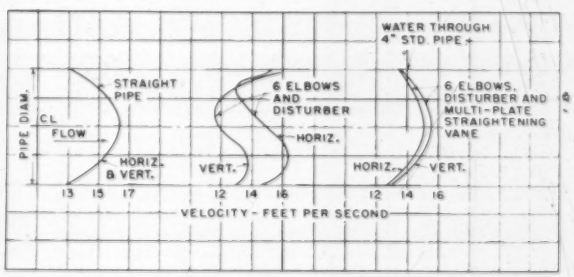


Fig. 6 Profile studies: horizontal and vertical traverses across the pipe, made with a pitot tube. At the left are the curves (superimposed) for flow in straight pipe. The middle curves show velocity patterns generated by the six 90-deg elbows supplemented by a disturber, considered to provide maximum turbulence. At the right is the pattern made after the introduction of the multiplate straightener. The traverses were made two pipe diameters following the vane.

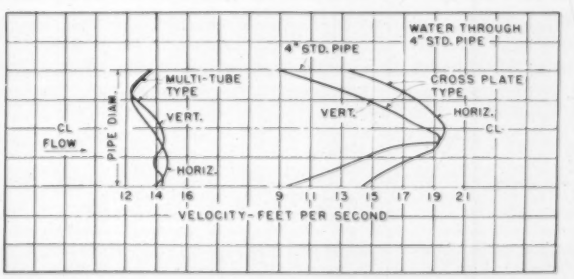
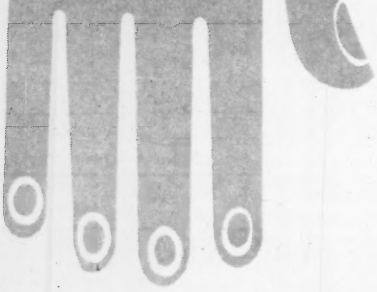


Fig. 7 The nature of the flow, as revealed by traverses made with the pitot tube after installations of the cross-plate straightener and the multitube straightener. The velocity patterns are poor compared with those of the multiplate type shown at the right in Fig. 6.



An experimental course at the University of Minnesota brought students under the tutelage of accomplished designers from a leading engineering firm. Results promise well for the future.

Developing Creativity in Engineering

By D. G. Taylor[1] and R. C. Jordan[2]

Because creativity in design finds its best climate in industry, rather than the college classroom, an experiment has been tried at the University of Minnesota. The Institute of Technology and the Mechanical Engineering Department explored the possibilities of a joint venture, in which an engineering firm would send its leading designers to bring the techniques of invention to students of mechanical design.

The Minneapolis-Honeywell Regulator Company agreed to co-operate. The company provided as instructors two of their senior staff engineers, each with a long list of U. S. patents and other creative contributions to the company, and each with over 25 years of professional engineering experience at Honeywell.

The class was kept small, a registration of 12 to 15 students. All were in their last undergraduate year, and all had completed the required senior machine-design courses.

Design courses usually involve the assignment of problems having a unique mathematical answer. In industry, in contrast, engineers are normally faced by situations with the actual technical problems undefined. Identification of the problem often constitutes over half of the job. There are many possible answers to a given problem, and the professional engineer must depend on his own judgment and the judgment of his associates. The class was told that the instructors would place them in situations similar to those which the professional engineer encounters, simulating the experience of the creative engineer in industry.

In one period of the class, the full development of an exceedingly complicated design problem, in which both of the instructors had been involved, was discussed in all of its aspects. This problem was the design, from concept to finished product. of the automatic pilot used for control of aircraft flight Here the situation had been one of severe prewar and early war urgency, and much sincere but mistaken misinformation was provided the engineers. It had finally been necessary to completely instrument a number of airplanes to find out what pilots really did in flying an airplane, in contrast to what they thought they did.

The Creative Process

An early session was devoted to discussions of creativity. One of the engineers had attended several symposiums on the subject of creative engineering and product design, including one taught at Massachusetts Institute of Technology under Professor John E. Arnold. The various psychological blocks to creative thinking were discussed. These included, for example, such perceptual blocks as the failure to distinguish between cause and effect, and the difficulties involved in working with false data as in the case of the autopilot development. Cultural blocks were discussed; these included such factors as the desire to conform to accepted patterns, and the feeling that it is not polite to be too inquisitive nor to doubt too many statements made by your associates or superiors. Emotional blocks discussed included overmotivation to succeed quickly, the inability to relax and allow incubation to occur, and the pathological desire for security.

Several sessions involved brain-storming techniques as developed by Alex Osborn of Batton, Barton, Durstine and Osborn. The class was challenged with problem situations from four different areas of engineering activity, and each of these was initiated by a brainstorming session. For example, the instructors were currently involved in an unclassified military project having to do with a weather station for military airports. One of the facets of this problem taken to the class

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[2] Professor and Head, Department of Mechanical Engineering, University of Minnesota, Minneapolis, Minn. Mem. ASME.

Contributed by the Management Division and presented at the Annual Meeting, New York, N. Y., Dec. 1–6, 1957, of The American Society of Mechanical Engineers. ASME Paper No. 57—A-182.

involved a 24-hr strip chart record of rain and the provision for an instantaneous indication of the rate of rainfall. In one brain-storming session the class developed 53 different approaches to the problem of measuring and indicating rainfall.

In a later appraisal session they rejected the more fanciful methods and those which would require an extensive amount of research, to realize a useful system. The instructors found that after one or two brain-storming sessions the students were overstimulated, and it was necessary to bring them back to earth. Following sessions were therefore devoted to a study of the development procedures—from initiation of the project to the final release to production—with emphasis on the fact that the early brain storming and subsequent analysis must be done very thoroughly. Otherwise, at the end of the long development procedure and appraisal phases, all the work accomplished might have to be abandoned when someone came up with a better idea.

The Graphic Art

Toward the end of the quarter the instructors became aware that the students had considerable difficulty in expressing themselves graphically. Since communication of ideas is necessary in creativity, one of the class sessions was devoted to three-dimensional sketching by an unusually gifted artist and draftsman who demonstrated one, two, and three-point perspective. Before this single session had been completed, all of the students were sketching three-dimensionally with reasonable finesse, a facility which engineers should develop. Industrial examples were shown where the use of three-dimensional drawings had saved months of time and thousands of dollars.

The creative engineer should know when, legally, he has created something; hence two lectures on patents were included. An illustrated lecture on the esthetic side of creative engineering was given by one of the partners of the Henry Dreyfuss firm of industrial engineering.

Appraising the Student

At the end of the course, an appraisal conference was held between the mechanical engineering staff and those involved from Honeywell. One interesting facet of the resulting discussions concerned the appraisal of the individual student by industrial standards. At no point in the course had the instructors been made aware of the relative class standing of the students involved. The results showed no real correlation between the industrial appraisal of creativity as compared with academic standards. In fact, two of the students close to first choice by the Honeywell engineers were among the lowest in their academic standings. Some apparent correlation did exist between the six preferred students (of the 15) and those who had more than normal prior industrial experience.

These facts agree with cases of which many educators are aware. The occasional nonconformist or "maverick" may rebel against regimented class-acquired knowledge, and perhaps for this very reason chooses unconventional and imaginative approaches to the solution of problems requiring creativity. Our normal grading system places undue emphasis on rote knowledge and conventional analytical procedures, with too little recognition given the unconventional integration of knowledge into new concepts and new mechanical solutions to problems.

The ability to carry through creative thinking seems to depend strongly upon the student's resources in the way of personal experience and personal knowledge. The rain-measuring problem is an example. Every student in the class had seen rain—heavy, light, vertical, and horizontal, fog, mist, and dew. Here the background and knowledge were sufficient to permit the development of new relationships between physical phenomena learned earlier in classes. In other cases where the instructors attempted to provide resources in areas relatively foreign to any experience the student had ever had, the results were much less impressive.

The Student Speaks

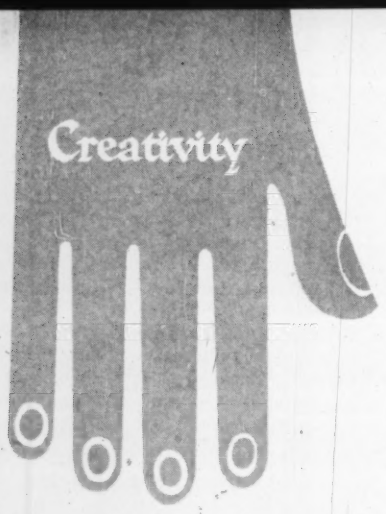
The three courses which have now been completed in creative engineering have been highly successful. Among the students, opinions of all parts of the course were not unanimous, yet a few excerpts from student comments will indicate typical reactions. One student wrote: "This (the autopilot) was perhaps the first actual invention that was ever explained to me. It gave some insight into the field of invention and showed the considerations you must take into account when trying to (develop) an item. I had never before realized the great amount of time, expense, and teamwork which must go into an invention." Another wrote: "In my estimation the course as taught is a huge success. This new slant on teaching gives the course a professional flavor which is hard to duplicate by any other means." A third wrote: "An important reason why interest was high in this class was that the information conveyed to us was fresh from industry. The problems given by each lecturer were typical of the type with which he is confronted. It gave me confidence to find that our solutions to these same problems were workable."

The instructors themselves were able to adjust rapidly to the climate of teaching this course. For many years each instructor, within the framework of industry, had primarily been teaching engineers and engineering supervisors. Furthermore, the subjects taught in industry have, as a central core: Situation analysis, problem identification and solution, design procedures and techniques, trouble-shooting procedures, design maintenance after release, and engineering development proposals—all calling for creativity and analytical ability. The company regarded the course as a new mechanism for aid to education and for the improvement of mutual respect and understanding with the University.

Conclusion

From the standpoint of the University, the Mechanical Engineering Department regarded this as a highly successful experiment, of value not only to students but staff as well. Direct knowledge of current and usually incompletely solved industrial problems was brought directly into the classroom to provide a living environment, unquestioned by the students and injecting the full gamut of creative techniques.

It is intended that the course will be offered perhaps twice a year. Staff-time contributions may come from other companies, in the future, to broaden the base of operations and viewpoints. It must be recognized that a course of this nature can be successful only if industry is willing to provide the very best of its senior talent in such a university-industry co-operative venture.



Industries and colleges have collaborated in the development of tests, devised at Iowa State College, aimed at determining a candidate's aptitude for creative machine design

The Potential Machine Designer

By J. F. Downie Smith, Mem. ASME
Dean of Engineering
Iowa State College, Ames, Iowa

UNDER contract with the Office of Naval Research, Iowa State College has devised and developed tests for picking out students who have special capacity for creative machine design. Success with such tests will give added impetus to the new college curriculums in this vital but neglected field of mechanical engineering.

The need for designers is great, and the situation is deteriorating. Our young mechanical engineers turn away from machine design, seeing the drawing board as a dead end for their careers. Industry has not yet given competent designers the social prestige and income of engineers who go into management.

In the medical profession, those who excel technically are the best paid and have the greatest prestige—skilled brain surgeons or heart surgeons, for example. This presents a contrast to engineering, and there is need for readjustment of management sights if engineering is to avoid more serious shortages.

The Machine Design Division of the ASME, aware of the repugnance of the young mechanical engineer toward machine design, is working through a group of men who will, upon invitation, speak to engineering students on the future possibilities in the field.

The Machine-Design Student

Recently, several colleges have revised their curriculums to make the machine-design sequence more stimulating and attractive.

The present aptitude study was aimed at enabling colleges to locate students, at the junior level, who have superior ability for machine design. It was intended to create tests which would be answered differently by creative and noncreative designers. The two groups were defined as follows:

Creative designers: Persons who have demonstrated the ability to comprehend the nature of a design problem, and can produce a novel, ingenious, or original solution in the form of a total, functional, and practical mechanism. Creativity, in this sense, does not necessarily involve the conception of an entirely new principle, but does involve the combination of existing principles or mechanisms in such a way as to produce a new and unique solution to a previously unsolved problem.

Noncreative designers: Persons whose major function is to work out the details of a design; that is, the engineers who do not produce original ideas, but who work out the routine problems of what materials to use, and who smooth out the design according to established procedures.

New Tests

Because of the relatively restricted nature of the creativity to be tested, the more general tests described by other investigators were not adequate. Nine new ones were created. These may be described as follows:

1 ***Power-source apparatus***—Given a power source and a motion sequence, sketch as many intervening mechanisms as possible. Scores: Absolute number and number "workable."

2 ***Design a machine***—Given a particular purpose to be served, sketch as many appropriate mechanisms as possible. Scores: Absolute number and number workable.

3 ***Applications of mechanisms***—Given a particular mechanism, enumerate as many types of machines in

Contributed by the Machine Design Division and presented at the Annual Meeting, New York, N. Y., Dec. 1–6, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. ASME Paper No. 57—A-181.

which it might function as possible. Score: Number listed.

4 *Three-dimensional space relations*—Fold a flat pattern to form a cube and then indicate the positions of three faces following various patterns of rotation. Score: Number correct.

5 *Figure matrixes*—Derive the rules by which a figure evolves, in two dimensions, and apply these in order to supply a missing figure at any given point. Score: Number correct.

6 *Number series*—Derive the rule or principle by which a series of numbers is generated and apply it to supply certain missing numbers in each series.

7 *Unstructured test*—Given a series of meaningless, incomplete, "mechanical-type" drawings, indicate what they could be, how many different things can be seen in each, and circle the relevant parts. Score: Number of objects identified, number of responses per minute, number involving motion, number of line segments used in each response, number of machines identified, and per cent of machine responses.

8 *Personal inventory*—A paired-statement inventory of 197 items dealing with interests, opinions, attitudes, personal characteristics, and experiences. Score: Number of responses typical of the creative machine designer.

9 *Personal history form*—A single sheet dealing with personal background and score like the Personal Inventory.

Trial Run

All of these tests and questionnaires were tried on groups of creative and noncreative machine designers in industry. Someone in responsible authority from each co-operating company rated the men as creative or noncreative. The men were matched by the company for age, education, and experience. The procedure was repeated with different people to minimize chance differences.

In the first set of tests there were 70 men from nine companies. This group took Battery A, consisting of tests 1, 4, 5, 8, and 9. In the second set of tests, Battery B, the men took tests 2, 6, 7, and 9. In this case there were 66 men from seven companies. Each of these groups contained both creative and noncreative engineers, and each battery took about one-half day to answer.

Test 3 is not listed. It was found, after the first two sets of tests had been answered, that there was one atypical item in the original Power Source Apparatus Test which discriminated perfectly between the creative and noncreative. Thus a new test was built on Applications Mechanisms, composed of items of this sort.

Men of Proved Ability

Another indication of creativity in machine design was obtained from the records of the U. S. Patent Office. A group of 76 outstanding men who had patented many devices of a machine-design character was examined. These men averaged 22.6 patents each from 1947 through 1951, and the minimum was 13. They answered the forms on Personal Inventory and Personal History, 8 and 9 of the tests listed.

Then all three groups were cross-validated and it was found that only four of the nine tests were serving in any useful way in separating the creative from the noncreative. The validation Battery, consisting of tests 1, 3, 8, and 9, was then given to 159 new men in 15 different companies.

It might be noted that the inclusion of the men with many patents merely accentuated the differences between the creative and noncreative already noted in the personal-inventory and personal-history tests cited. For those statistically minded, the data were largely treated by the t-test, chi-squared test, point bi-serial correlation, multiple regression, and discriminant function.

Before any item in any of the tests was included in the final validation Battery, it was evaluated to make sure that any variation was appreciably greater than could be attributed to chance.

Results

The combination of the four validation sample tests, when pooled for all men tested, gave a correct classification in 66 per cent of the cases. When applied to individual companies, however, the correct classification is 86 per cent. These might be put, then, as the two limits between which the average case might be expected to lie. Thus about three quarters of all those tested would be separated accurately between creative and noncreative.

It should be pointed out that we were working with the least favorable case of equal numbers of creative and noncreative. If we were trying to pick 10 out of 100, the validation would be much higher.

Application to College Students

But what about college students? Could the creative and noncreative be separated similarly? Or is there an industrial experience factor which would show up?

Engineering colleges were asked to give the tests to seniors, and, in some cases, to juniors. Twenty-five leading colleges and universities co-operated, and a large number of tests were taken and forwarded to Iowa State College. These tests are now graded and filed in our vaults. It is our expectation that the students tested will be checked after a few years in industry to see if the results of the tests bear out their industrial experience. If they do, then we can conclude that such tests can be used for screening at the end of the junior year in college, enabling the faculties to give special, stimulating training to those with design potentialities.

For this to be effective, of course, there must first of all be available competent stimulating members of the faculty. Industry must realize that it cannot keep raiding the colleges of outstanding teachers and expect to get the best possible graduates.

Should any organization wish to use these tests they should write to Dr. W. A. Owens, Head, Department of Psychology, Iowa State College, for further information. The tests have to be graded by someone versed in the art, and this will be done at nominal cost. For obvious reasons the tests themselves should not be published, and are thus not reproduced here.

Acknowledgments. The author wishes to express his appreciation to the Office of Naval Research for supporting this project, and to the 25 colleges and 26 industrial firms which co-operated in the tests. The work was largely done by the Psychology Department at Iowa State College, under Dr. W. A. Owens, with the co-operation of the Mechanical Engineering Department, particularly Prof. L. S. Linderoth, Mem. ASME.

An outline of the elements that underlie creative talent: How these factors may be evaluated in selecting creative engineers

Characteristics of the Creative Engineer

By G. J. Spencer
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CREATIVE talent is the capacity for conceiving and producing something new and original—whether product, procedure, theory, organization, or idea. It is believed to be a function of certain personality characteristics, revealed chiefly in the developmental history of the person and in his behavior patterns.

The qualities which, in some form or another, are included in every creative process are: Compulsiveness, intelligence, visual imagery, controlled imagination, and a spirit of rebellion. What is important is the interrelationship and balance of all these elements.

Compulsiveness

The quality which primarily serves to channel, sustain, and reinforce the utilization of energy is compulsiveness. Compulsive people are, almost invariably, hard workers, and hard work is an ingredient of creative talent, even though the individual makes what is hard look easy.

Compulsiveness stems from early conditioning in childhood and later reinforcement in adolescence and early adulthood, roughly according to the following sequence: Complete dependency upon the parents, conflict (emotional situation) with the parents over their demands; compliance with the demands of the parents; parental approval of compliance; pride in approval of achievements or production; willingness to work to win approval and enhance self-esteem; establishment of this pattern of work behavior.

Compulsive behavior is a means of relieving tension when the individual is confronted with a conflict (emotional situation). Such behavior—such reaction to conflict—becomes habitual, and its identification with the original situation is lost. In all compulsive behavior, the individual feels the necessity for executing some act or series of acts, and seems to obtain relief by carrying out the compulsive behavior.

The compulsive man is not only interested in his work, but obtains relief from tension by engaging in it. This is a strong driving force. All engineers rank relatively high on the scale of compulsiveness. However, what usually differentiates the creative engineer from the competent engineer is that he is more compulsive—in fact, he can be described as obsessive-compulsive.

Intelligence

It is generally agreed that there is no such thing as any absolute level of intelligence divorced from personality influences. For our purposes, intelligence may be defined simply as the ability to perceive relationships and to solve problems.

The essence of creative talent seems to be the capacity to perceive new relationships. This ability develops with experience and usage, at least in a specialized field, and given other necessary personality traits. For example, many aspiring young authors have difficulty in "thinking up" plots for stories, whereas a professional author like Somerset Maugham (as he has stated) has more ideas in mind than he could ever hope to put on paper. To paraphrase a saying, "Them as has ideas, gits more ideas."

If intelligence, in our sense, is to be a component of

creativity, it must remain flexible in its functions, willing to rearrange things or break out of the customary manner of doing things. Such flexibility is a function less of intelligence than of personality.

It has been frequently observed that many men with high intelligence are not creative at all, by any usual standards, whereas men with relatively low intelligence are creative, as proved by their actual work, such as patents on new products or methods.

The answer to this discrepancy appears to lie in the balance of intelligence with the other personality characteristics. For example, consider intelligence in relation to compulsiveness. An individual who is relatively low on intelligence but high on compulsiveness may have a higher rate of exposure to perception of new relationships than the man with high intelligence and low compulsiveness. Furthermore, this compulsiveness may impel him to follow through on his perception in a practical way—not only to conceive an idea but to act on it—whereas the more intelligent man might stop with the perception.

This seems to be one of the reasons why so-called tinkerers, for instance, are often more creative than graduate engineers. They eternally keep at their tinkering, often on a trial-and-error basis. In so doing, they increase the statistical probabilities that they will arrive at a workable solution.

Visual Imagery

Since imagination is such an important component of creative talent, it is advisable, from the standpoint of both theory and practical evaluation, to divide it into two parts. One part is here called Visual Imagery and the other, Controlled Imagination.

By visual imagery is meant the ability to call up a projection or conception and to manipulate it so that it is abstracted from and no longer dependent on the sensory system itself. The essential elements seem to include (*a*) a pleasure in visual perceptions for their own sake; (*b*) acute perception of the present; (*c*) projection of perception into a synthetic future; (*d*) facility in changing focus, step by step or stage by stage, from present to future.

There are many metaphors in common use which link such perceptions to personality and intelligence. We say, for example, that a man takes the long view, or that he can't see the forest for the trees, or has a suspicious eye, or looks at the world through rose-colored glasses. All of these statements imply a continuity of personality projected into the future as expected behavior.

It is a common complaint that many engineers deal with work in a mechanical, unimaginative fashion. All of their attention is focused on details whose handling becomes an end in itself. It does not even occur to them to visualize the materials, men, and problems which are represented. As a result, they make many literal-minded mistakes because they are deficient in visual imagery. Creative engineers, on the other hand, are able to visualize all the elements of a situation and formulate a comprehensive approach to the problem.

Controlled Imagination

Where visual imagery refers more to the surface or behavioral manifestations of imagination-and-personality, controlled imagination refers to the deeper or motivational levels.

As defined here, the imaginative continuum is believed to include not only sensory imagery, but also hypothetical ideation, fantasy, fancy, wishful thinking, daydreaming, a tendency to escape from reality, and schizophrenia. What all of these have in common is a transfer of attention from the world of actuality to a world of make-believe.

At the upper end of the continuum there is a controlled, disciplined, discriminating imagination with sharp awareness of what is real and what is imaginary. At the lower end of the "normal" continuum, there is vague, uncontrolled day-dreaming with weakened ability to distinguish reality from dreams. When the continuum crosses the line into pathology, there may be extensive withdrawal from reality, as in schizophrenia.

At the upper end, imagination is thought of as an aspect primarily of intelligence, unless we also keep in mind the continuum as a whole. At the lower end, it is clear that uncontrolled imagination results from some quite specific personality factors with the intellectual aspects representing secondary manifestations.

Anything which takes a person "out of himself" has an imaginative element—for example, music and reading. Of course, here we have to differentiate between the kind of music and reading, the purpose of the individual engaged in it, and the extent to which he indulges in it. It can be stated that the man who indulges extensively in music or reading is more likely to be imaginative than one who is concerned only with the practical necessities of living. At will, he is able to "enter another world" of rhythm or make-believe.

The Dream World

Everyone, it is safe to assume, has a fantasy life of his own. These vary tremendously from individual to individual. From a practical point of view, what is important is the direction and extent of his fantasy life and his control of such tendencies. Happy and successful—generally speaking—is the man whose dreams reinforce his efforts. As the saying goes, he "lives his work." (Of course, some men who live their work are pathologically compulsive; again we emphasize the importance of "balance.")

Some controlled imagination, as defined here, is present in all creative enterprise, whether by artist, inventor, research scientist, or business originator. Such men are able to "see" things, both in actuality and as they might be in the future. They bring a fresh viewpoint to problems, perceive relationships in new and different ways, and so arrive at original solutions.

Original solutions by definition involve novel ideas. If we think of imagination as an element which is, at least in part, "out of this world," then obviously it creates greater opportunity for novelty of ideas than when the person deals only with things familiar to him in actuality. In the same way, thought is clearly more flexible, less rigid. At the same time, creative work that is to be realistic or accepted must be done with some evaluative restraint. This is the reason why we use the term "controlled imagination."

The Dual Focus

This trait also seems to involve what is customarily

thought of as an empathic or intuitive element. Thus we may say of a creative artist that he has an abnormal sensitivity or "feel" for his medium of expression; or that his instrument (sculptor's chisel, painter's brush, surgeon's scalpel) becomes a living extension of himself; or, in the case of an engineer, that he is able to get "inside the skin" of the problem and see it not only from outside in, but inside out. Apparently what is involved here is a kind of dual focus, including both sharp perception of actuality and imaginative manipulation of contributory concepts, which the man with creative talent is able to fuse and to keep in phase.

Furthermore, controlled imagination probably enables the individual to tap the resources of his unconscious mind and put it to work in a way which would not be possible to a man who is severely practical and matter-of-fact. Thus relationships often seem to group together in the unconscious and, at a favorable moment—after a night's sleep, for instance—surface into consciousness as a flash of insight which solves the problem.

An important point here is that the creative individual has a larger and more active unconscious mind than the noncreative individual. He stores it with imaginative conceptions and frequently manipulates these conceptions, bringing to consciousness those which seem useful and allowing the others to submerge again. In brief, he keeps his unconscious mind well stocked and activated as a kind of silent partner in the generation of ideas.

Spirit of Rebellion

The final important element in creative talent is a spirit of rebellion against established authority. While this characteristic is emotionally based, it also has intellectual aspects because it enables the individual to attack the boundaries of existing knowledge. Furthermore, it reinforces an inhibition against closure until the problem is solved.

Originality of thought requires more than accumulation of knowledge, more than acquisition of degrees. After a survey in which it was found that a person with engineering or scientific training had only half the probability of making an invention compared with others, Charles Kettering commented that an inventor is "a fellow who doesn't take his education too seriously."

Secondary motivation

A spirit of rebellion not only enables the individual to attack accepted limits of thought, but it also provides a secondary motivation for achievement. This motivation develops as follows:

1 In essence, the individual is rebelling against his father (or other parental or authority figures, or the restrictions imposed by such authority).

2 As a result, he develops feelings of guilt, which may be partially or entirely at an unconscious level.

3 Also, he encounters difficulties, which inevitably attend any rebellion against established authority.

4 These difficulties symbolize parental punishment for his sin of rebellion.

5 Therefore by undergoing this punishment and overcoming the difficulties, the individual is able to "expiate" his feelings of guilt.

6 Finally, by winning through to success and proving the superiority of his own ideas, he is able to justify his rebellion.

Of course, as soon as the individual is successful, his ideas become part of a new established authority. It frequently happens that the *enfants terribles* of one generation become the conservatives of the next, as issues which once were revolutionary become accepted and commonplace, and in turn are either attacked or bypassed. Thus the cycle renews itself.

Another motivation for achievement, allied to the sequence listed above, is this: In the attempt to prove the superiority of his own ideas, the individual inevitably makes a strong ego-involvement in them. He has to be creative or bust. This motivation not only reinforces compulsiveness, but takes over where compulsiveness leaves off.

Conclusion

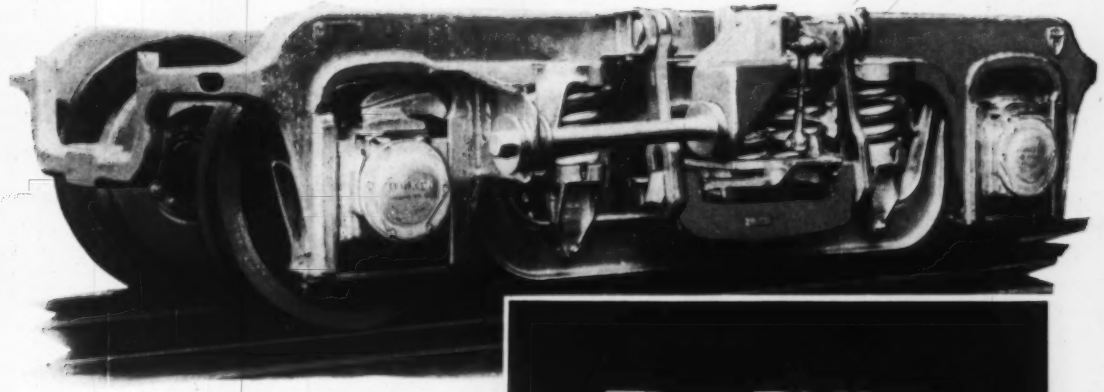
These five characteristics—compulsiveness, intelligence, visual imagery, controlled imagination, and spirit of rebellion—provide necessary elements for creative talent. To be used effectively they should appear not only in combination but in balance.

In addition, there should be reasonably good balance with other personality characteristics which, while they are not primary elements of creative talent, nevertheless may strongly influence its functioning.

It is believed that creative talent exists along a continuum; there is no clear dividing line between people who are creative and people who are not creative. And the creative continuum is, obviously, influenced by external conditions, as illustrated by the axiom that "necessity is the mother of invention."

Nevertheless, from the standpoint of practical evaluation of engineers, some individuals clearly possess creative talent; many individuals have so much less that it may be considered absent; and in between, there are men who possess some elements of creativity in varying mixtures. The talents of this in-between group may come to fruition under favorable circumstances, but otherwise are likely to be lost.

It should be emphasized that the elements of creative talent discussed here represent basic personality traits which become well established at a relatively early age, certainly by high school graduation time. It should become increasingly possible—using all approaches to the analysis of creativity, on which a great deal of research is being undertaken—to identify boys and young men with exceptional potentials, and to provide them with the kind of engineering education and training which will best develop their creative talent.



The Riding Comfort of Railroad Passenger Cars

Track design and maintenance, track repair and alignment, and car-body construction are essential to . . .

By W. E. Burdick, Mem. ASME

Engineer of Tests,
General Steel Castings Corporation, Granite City, Ill.

MANY factors affect the riding comfort of railroad passenger cars—truck design and maintenance, track repair and alignment, and car-body construction.

The modern passenger truck illustrated in Fig. 1 is the outgrowth of the first cast-steel passenger trucks with integral pedestals made by Commonwealth Steel Company in 1904, and which came into general use by 1920. Roller bearings introduced in 1927, the unit clasp brake in 1929, and off-tread brakes in 1938 have contributed much to riding comfort.

The figure shows off-tread brakes. Either tread or off-tread brakes are provided. Similar features with the addition of a pair of wheels are found in the six-wheel type, for heavier cars. The author has found little difference in the riding comfort between the four and six-wheel trucks. Features of the modern truck are:

1 A one-piece frame with lined, integral pedestals to insure wheel alignment, and ruggedness to minimize maintenance.

2 Roller-bearing boxes, a "must" for smooth high-speed operation, without "hot boxes."

3 High-speed brakes with wheel-slip control to insure a smooth, minimum-stopping distance.

4 Rubber-cushioned draft anchors for easy transmission of longitudinal forces from the wheels to the car body.

5 Equalizer coil springs to cushion rail impacts. Equalizers keep weight on both boxes in case of spring breakage, preventing derailments from this source.

6 Shock absorbers across the bolster springs preventing resonant build-up.

Contributed by the Railroad Division and presented at the Annual Meeting, New York, N. Y., December 1-6, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Paper No. 57—A-153.

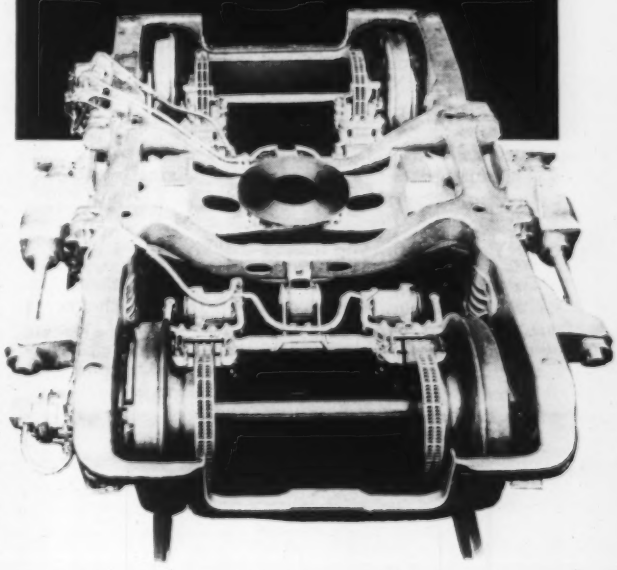


Fig. 1 Modern four-wheel passenger truck: off-tread brake shown, tread brake also provided

7 Fabric damping pads at springs, equalizer feet, and swing hangers to reduce transmission of noise and high-frequency vibrations.

8 Bolster suspension outside the truck frame for ready inspection and fast renewal of defective parts.

9 Swing hangers in combination with the shear deflection of bolster springs to produce soft lateral action.

10 The central bearing to prevent shimmy.

11 Resilient coil springs supporting the bolster on a wide spring base, providing roll stability.

The lean of cars on curves affects riding comfort (1)[1] and involves the clearances between cars on passing track. The Union Pacific conducted tests to show the comparison in lean between a dome car with outside-swing-hanger trucks and a prewar sleeper with inside-swing-hanger trucks (2). It was found that the two cars at 6 in. unbalanced elevation for static and dynamic tests compared as follows

	Static lean inward, in.	Dynamic lean outward, in.
Dome car—outside swing hanger trucks	6.60	7.20
1941 sleeper—inside swing hanger trucks	9.60	12.30

Note from the foregoing that the transverse displacement for the outside-hanger truck for static lean was 3 in. less than that of the inside-hanger truck and for the dynamic lean, 5 in.

Maintenance

A poorly maintained truck will soon drive away traffic. The modern truck is designed for easy maintenance, but no piece of machinery can run indefinitely without attention.

The truck components are gaged to insure that, when assembled, parts will function properly without binding or fouling. The one-piece cast-steel truck frame maintains its alignment indefinitely, excepting for wreck or abuse, and it is only necessary for the maintainer to renew worn parts to restore it to its original true condition.

Other Factors Affecting Riding Quality

To insure that the four corners of a car have equal spring deflections it is necessary to know the actual weight carried by each spring. The weight of each end of the car may be obtained with a conventional track scale. The weight of each side of the car may be obtained by means of three-point support weighing, where one end of the car is supported on a ball and socket with the weight distribution of the opposite end determined by electronic load cells (3). Both ends are similarly weighed, and by rolling the car through known angles, the location of the center of gravity longitudinally, transversely, and vertically may be readily determined. The overturning speed on curves can be determined when the vertical location of the center of gravity is known.

Proper brake application and slack control, negotiating curves with regard to speed restrictions, starting and stopping, and control of trains through changes in profile can contribute substantially to the riding quality.

Cylindrical-tread wheels have less tendency to hunt, and thus impart less lateral motion to the truck than do tapered wheels. The only difficulty is that they do not stay cylindrical long; after a few thousand miles they become worn so that the beneficial contour is lost.

Riding conditions affected by wheel unbalance and eccentricity were investigated by the AAR (4), who found that:

"The detrimental effect of wheel unbalance on the riding of the test car was inconsequential when the total unbalance per wheel was below 2 lb at rim radius. The investigation of the effect of wheel machining shows that the limiting condition of wheel unbalance can be met by the semifinish machining of wheels.

"Wheel-tread eccentricity (up to 0.035 in.) had no important effect on the riding of the test car."

The quality of track affects the ride. Correlation between track conditions and riding qualities has been established by a number of railroads by operating a ride recorder over their lines, pin-pointing rough spots for attention of the track department.

The coil springs themselves may set up annoying vibrations such as hum and rattle. Hum is of the order of 50 cps and, when excessive, causes a rumbling sound within the car. Investigations show that this hum is caused by surge of the spring, which is a relative vibration of the middle coils with respect to the end coils, Fig. 2. Insulation against transmission of this vibration to the car body has been partially successful. Rattle of springs can become very disturbing. This appears to be caused by nested coils impinging on each other. The solution for this problem is to increase the diametral clearance between coils, and center them with each other.

Noise is often mistaken for rough riding, and proper noise insulation throughout the truck and car structure can do much to increase passenger comfort, particularly on sleeping cars.

Noise and vibration annoying to passengers can originate in the end-draft connections and diaphragms, and are often mistaken for truck noises. Maintenance here is required and much progress has been made in insulating these points with fabric damping pads. Rubber draft gears and "tightlock" couplers have helped to keep down "slack."

Testing Techniques and Observations

Instruments for recording riding qualities were available before World War II but not generally used on railroad passenger cars.

The Three-Way Ride Recorder was developed by engineers associated with the University of Illinois, and since the war has come into general use. The instrument records vertical, longitudinal, and lateral

[1] Numbers in parentheses refer to Bibliography at end of paper.

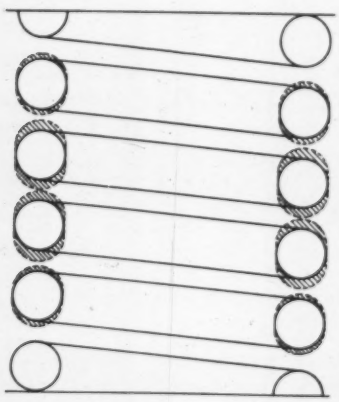


Fig. 2 Mode of vibration producing spring hum

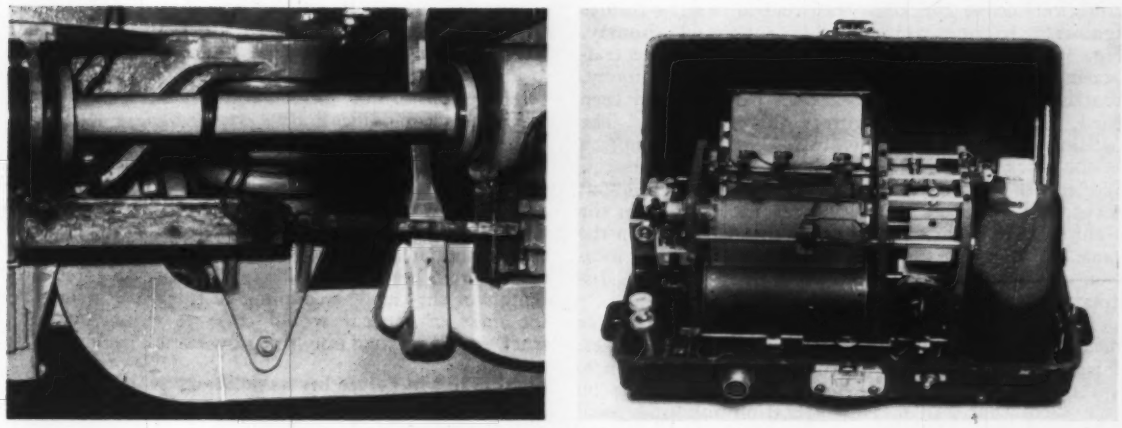


Fig. 3 Motion indicators are used to record truck motion

car body accelerations, and within its frequency response reproduces the impressed accelerations with fair accuracy. Mileposts or other information may be coded on a chart by means of a marker. The chart is clock-driven at 6 in. per min so that the distance between milepost marks, in seconds, may be used to establish operating speeds.

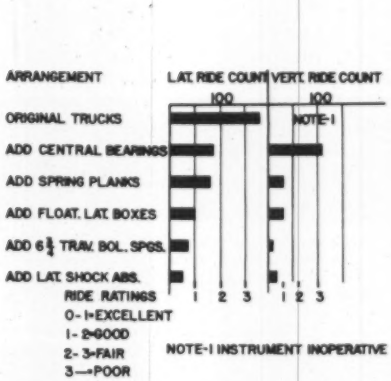
When more detail is desired, electric accelerometers are used. Motion indicators can be readily constructed from spring-steel strips with a strain gage. These strips are clamped to one truck member and driven by an adjacent member. Relative motions between the two produce signals, which are calibrated and recorded on an oscillograph. Fig. 3 shows a motion indicator to record truck motion.

There are a number of accelerometers of the "impact-counting" type in use. These instruments totalize the disturbances reaching certain preset intensities and are useful in an over-all evaluation of the riding qualities of a car. They do not locate points of disturbance.

A test program carried out on a "problem car" will illustrate the testing technique. This car, a bedroom-lounge, was reported for rough riding. It was equipped with inside-hanger trucks with the following characteristics: (*a*) conventional center plates, (*b*) roll stabilizers, (*c*) restricted lateral journal roller bearings, (*d*) bolster coil springs with $3^3/_4$ in. static travel. Changes were made to this truck, one at a time, as follows: (*a*) central bearings replaced center plates, (*b*) spring planks replaced roll stabilizers, (*c*) free lateral boxes applied on new wheel-axle assemblies, (*d*) static travel of bolster springs was increased from $3^3/_4$ in. to $6^3/_4$ in., (*e*) lateral shock absorbers were added.

The ride recorder was used to check the riding quality of the car and to provide statistical data for grading the ride. Runs were taken over about 12 miles of main-line track at practically the same speed and the car was in the same consist position. Since the test extended over a 2-yr period, wheel changeouts were inevitable, but most of the data were based on low wheel mileage with 1:20 treads. No check was made of wheel unbalance. Duplicate runs, when made, showed consistent results. The quality of the ride is numerically established by summating the excursions of the recording styli by lines crossed, and obtaining the average per mile. Based on our riding experiences we have established a grading of riding comfort. Fig. 4 shows a bar diagram of the ride values obtained by each change made to this car, from which it is noted that the riding qualities improved from poor to excellent.

A serious ride complaint is shimmy, which is a lateral vibration in the range of 3 to 4 cps (5). It usually develops at speeds above 60 to 65 mph and is ordinarily associated with a slight tread wear. When double flanging is observed, it is often caused by shimmy. By retarding truck swiveling on tangent track, this mode of



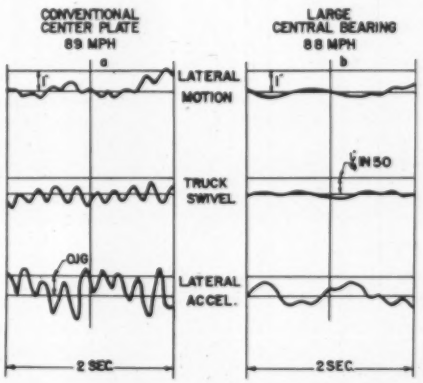


Fig. 4 *Left,* bar diagram of riding-quality improvements obtained with each change made to the car

Fig. 5 *Right,* oscillograms of the effect of central bearing application to a car: (*a*) car shimmy, before application; (*b*) after application of central bearings

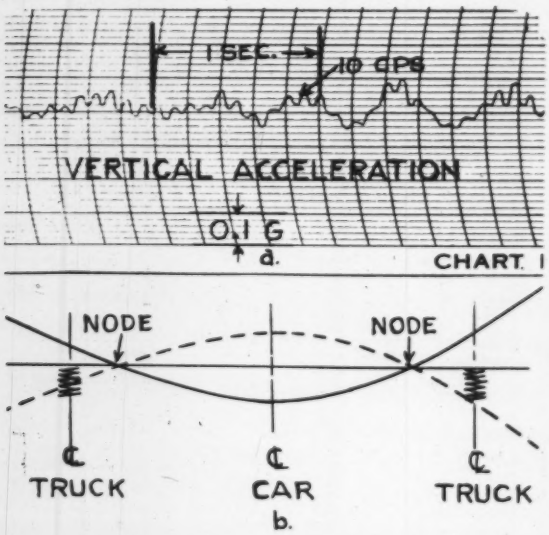
vibration can be checked. The central bearing rotates against a friction pad and thus suppresses shimmy. Fig. 5 shows an oscillogram of the effect of a central-bearing application on a car which had a severe shimmy. Practically, all of the then-known panaceas had been tried, unsucessfully, to correct this condition. The oscillograms on the left show, top to bottom, the motion of the truck laterally, the truck swivel, and the lateral acceleration of the car body. The frequency is about 4 cps, and all traces are in phase. The records on the right side show the effects of the central bearing on the same car, with the same wheels, at the same track location and speed. With swivel-control, shimmy has disappeared.

This oscillographic equipment is satisfactory for measurement of events in the riding range of frequencies. For higher frequencies in the sonic range, in fact from 20 cps upward, vibration measurements can be made on equipment that will measure vibration amplitude, and analyze the resultant waves. A tape recorder can be used to preserve these vibration patterns for later playback. With these instruments annoying vibrations can be traced to their source and corrective measures taken.

The eccentric oscillator can be used to trace the source of vibrations of 6 cps and upward. By this means one vibration in the order of 10 cps was pinned down to a car structure, as shown in Fig. 6. The oscillator was placed on the end of a car and when tuned to 10 cps, a severe car vibration was excited. Investigation disclosed two nodal points, over the inside edge of each truck from which the vibration pattern was found to be as shown. Accelerometer readings taken with the car in motion showed components of this frequency affecting riding qualities.

With the exception of shimmy, the most annoying lateral vibration in a car is due to yaw; that is, when the front of the car travels to the left, the rear travels to the right. This is a natural mode of vibration, and can be easily excited with the car at rest by a man using a crowbar. As the car travels along the track the natural

Fig. 6 (*a*) Oscillogram showing presence of 10-cps vibration (*b*) mode of vibration producing this frequency



hunting of the wheels will seek out this mode and can cause an almost continuous vibration to be sustained. The vibration will tend to be restrained by adjacent cars, so it is usually the most severe at the rear of the train. This motion is not particularly a function of truck design, since modification of swing-hanger length or angularity, spring stiffness or location, and other similar modifications will merely shift the natural frequency a slight amount.

Any means by which the hunting of the wheels can be checked, or kept from disturbing the truck, will improve this yawing motion.

If it were possible to place the trucks on percussion centers of the car, the coupling of the truck actions by the mass of the car would cease to exist, and each truck would respond only to its own track irregularities.

Possibilities in Future Investigations

The only logical approach to a completely satisfactory answer to the riding problem of passenger cars, appears to be in a concerted research program. The problem is not only the truck manufacturer's; it is equally the responsibility of the car builders, and the railroads as well. The very nature of the physical laws involved requires that the location of the trucks be established to suit the mass and radius of gyration of the cars. The railroads' collective responsibility is that they are selling $\$^3/_4$-billion worth of passenger transportation a year (6). In contrast to this volume of business, with some notable exceptions, little is spent in research into the most important commodity—the customer's comfort.

The research should be directed to one objective—the determination of the effect of all factors affecting riding comfort. A few of the items of investigation which the author suggests are:

1 To determine the radius of gyration about the three axes of the car by experimental means.

2 To restrict the effect of wheel hunting.

3 To determine the minimal track conditions for riding comfort.

4 To develop an oscillator which will vibrate the car in all of its critical modes, including the low frequencies associated with riding.

The economics of the new lightweight "dream" trains is now under study and experience will determine their future. Regardless of their final design, to be successful the new trains must be comfortable.

Acknowledgments. The author is indebted to the many railroads for permitting tests to be carried out on their equipment. The suggestions by the personnel of the author's company are acknowledged with gratitude.

Bibliography

1 "Passenger Comfort on Curved Track," Association of American Railroads AREA Bulletin No. 516, June-July, 1954.

2 "How Dome Cars Act in Curves," by D. S. Neuhart and W. C. Krautheim, *Railway Age*, March 19, 1956, pp. 66–68.

3 "Passenger Car Center of Gravity—How to Determine It and Why," *Railway Locomotives and Cars*, March, 1956, pp. 66–68.

4 "Effect of Wheel Unbalance Eccentricity, Tread Contour and Track Gage on Riding Quality of Railway Passenger Cars," Association of American Railroads, First Progress Report, April 4, 1950.

5 "Dynamics of 'Shimmy' in Passenger Car Trucks," by S. G. Guins, ASME Paper No. 50—SA-21.

6 Address by E. G. Budd, Jr., Proceedings of Interim Business Meeting of the American Association of Passenger Traffic Officers, New York, N. Y., 1957, pp. 18–21.

Abstracts and Comments Based on Current Periodicals and Events

D. FREIDAY
Assistant Editor

BRIEFING THE RECORD

12-Mill Nuclear Power?

THE operating power level of the Experimental Boiling Water Reactor, EBWR, has been more than doubled after 10 months of experiments at Argonne National Laboratory, indicating that the electrical output of the plant could be substantially increased. This would in turn reduce the cost of plant investment per unit of power considerably.

The increase in power from the design level of 20,000 kw of heat to 50,000 kw was achieved without change in the number or arrangement of fuel elements within the reactor core, but through increasing the heat by withdrawal of the control rods. With control rods further withdrawn than at the design level, water in the core boiled at a higher rate, resulting in faster recirculation through the core and more rapid removal of heat. The successful completion of the experiment demonstrates once again the inherent safety and reliability of the boiling-water reactor.

Safety precautions were rigidly observed by Argonne scientists and engineers in boosting the power output of the reactor. A team of engineers led by James A. DeShong, Jr., spent several months in carrying out a carefully planned set of preliminary experiments in which the performance of the reactor core at the higher powers was predicted with general accuracy.

If output were raised to three times the initial design rating, which is considered to be feasible, operating costs of the EBWR, already the least expensive of the power reactors to operate, would be reduced from an estimated 52 mills per kwhr to an estimated 32 mills.

According to J. M. Harrer, project chief for the reactor, "if four identical reactors of this type (operating at the expanded output) were built in one multiple-reactor station—with no extrapolation of design beyond what has already been learned—operating cost would come down to about 12 mills, partly because of lower fuel-fabrication costs."

"Twelve-mill power from a 40,000-electrical-kw power station is not economically competitive in the United States today," Charles G. Manly, chief, Commerical Development Branch, Division of Civilian Application, AEC, stated, but "if Harrer's estimated cost can be shaved by 25 to 35 per cent in actual practice, that is, 8 to 9 mills, we are in business in the world's largest power-equipment market. But we all know and must remember that the last increment of a cost reduction is generally the hardest to achieve. At least we have the target in sight, even if we are not quite within shooting range."

A complex casting made by the S-K-B ductile-iron process

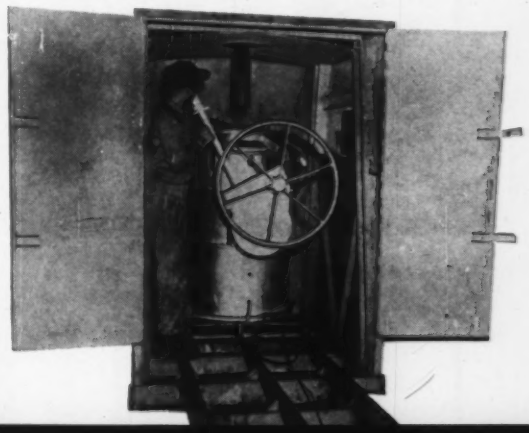
New Ductile-Iron Process

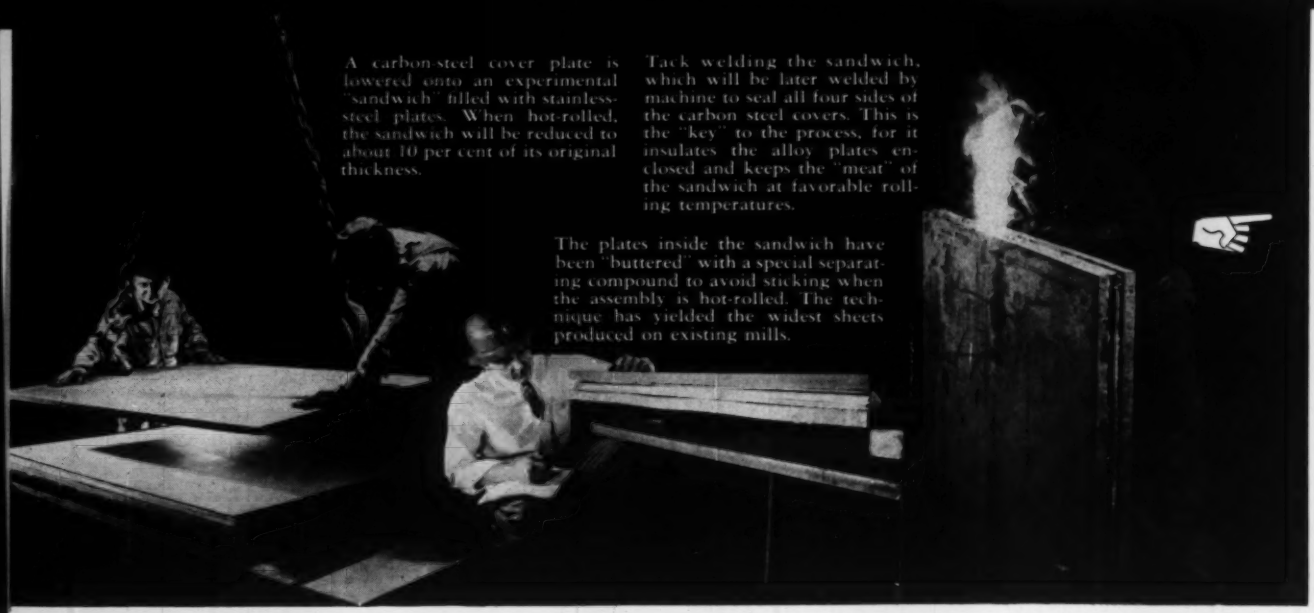
THE Cooper-Bessemer Corporation is one of the first licensees in this country to produce ductile iron castings by the Schuchtermann and Kremer-Baum process.

The unique feature of the S-K-B method used at Cooper-Bessemer's Mount Vernon, Ohio, foundry is that pure magnesium is added to the molten iron in a sealed ladle which prevents the magnesium from boiling by confining the magnesium vapors. The use of pure magnesium obviously prevents the loss of the other metals used for alloying in the regular process. Furthermore, by this method enough magnesium can be added to produce the spheroidal graphite, an essential constituent of ductile iron, when the treated metal is diluted with large quantities of hot, untreated base metal.

The company is a leading producer of centrifugal and reciprocating compressors, diesel, gas, and gas-diesel engines for all types of industry requiring compression of gases and development of power.

In the S-K-B process for making ductile iron, pure magnesium is added to the molten iron in a sealed ladle which prevents the magnesium from boiling by confining the magnesium vapors.





A carbon-steel cover plate is lowered onto an experimental "sandwich" filled with stainless-steel plates. When hot-rolled, the sandwich will be reduced to about 10 per cent of its original thickness.

Tack welding the sandwich, which will be later welded by machine to seal all four sides of the carbon steel covers. This is the "key" to the process, for it insulates the alloy plates enclosed and keeps the "meat" of the sandwich at favorable rolling temperatures.

The plates inside the sandwich have been "buttered" with a special separating compound to avoid sticking when the assembly is hot-rolled. The technique has yielded the widest sheets produced on existing mills.

Basic-Oxygen Process

PRODUCTION of steel by the basic-oxygen process has begun at the Aliquippa, Pa., works of the Jones and Laughlin Steel Corporation. Cost of the complete installation, designed and built by Kaiser Engineers, Oakland, Calif., is about $11 million. J&L, the nation's fourth largest steel producer, is the first major company in the U. S. to use the basic-oxygen steelmaking process. Two furnaces—only one of which will operate at a time—have a total annual rated capacity of 750,000 tons. They are the largest in the world.

The basic-oxygen process, which is regarded as an adjunct to the open-hearth method rather than a replacement, produces high-quality steel at a much lower cost than traditional methods. The basic-oxygen furnaces represent a capital investment of only $15 per annual ingot ton, as compared with at least $40 per annual ingot ton for new open-hearth facilities.

The process is a relatively simple one. It is carried out in a cylindrical furnace lined with basic refractories. The furnace is charged with scrap, with molten iron, and with slag-forming materials.

A water-cooled lance is lowered to a predetermined position above the surface of the molten metal. From the tip of the lance, a jet of high-purity oxygen is directed vertically at the surface of the molten bath, initiating thermochemical reactions that refine iron to steel.

While one furnace is making steel, the other will be relined, a job that takes about five days. The furnaces will produce at least 54 tons of steel per 37-min heat. In a 24-hr operating day, production will approximate 40 heats. The life of the lining is estimated at between 300 and 400 heats.

Steel made by this process will be quite low in nitrogen, phosphorus, and sulfur content, and consequently possess high purity and ductility.

Two identical substantially automatic oxygen-generating plants designed, built, and operated by Air Products, Inc., of Allentown, Pa., are the principal auxiliary to the basic-oxygen process. These produce 230 tons per day of 99.5 per cent pure oxygen, a stream of 99.9 per cent pure nitrogen, and the purest argon made commercially.

Because the oxygen-producing facilities utilize temperatures which are among the lowest ever used commercially, all the complex maze of pipes, valves, refrigeration, and distillation equipment is contained inside a giant "cold box." Air which enters the cold box warm, and under pressure, is refrigerated to about −300 F and separated into oxygen, nitrogen, and argon fractions in a distillation column. The products are then rewarmed separately and withdrawn from the plant.

An ingenious combination of air compressors and two separate heat-exchange systems is used in the process. A smaller system uses shell-and-tube heat exchangers in which the products of air distillation—oxygen, argon, and nitrogen—are passed through the exchanger countercurrent to the flow of incoming air, cooling the incoming air almost to its liquefaction temperature by means of the products leaving the plant. A high-pressure compressor maintains a balance of refrigeration capacity.

The larger of the two heat-exchange systems employs giant, rock-filled regenerator vessels and operates in perfect balance at a low input pressure, substantially reducing the air-compression requirements, and hence the power input for oxygen manufacture. Air at about 85-lb pressure is passed through one of two large beds of extremely cold pebbles which purify the air by freezing out water, carbon dioxide, and other possible contaminants. Before leaving the regenerator, the air is cooled almost to −300 F.

While the incoming air is being refrigerated in one regenerator, the other regenerator vessel is flushed of impurities and simultaneously cooled down to a very low temperature by outgoing cold-nitrogen product. Thus after a few minutes of operation, the flow is interrupted, the pressure equalized between the vessels, the flow reversed, and the cycle repeated.

In withdrawing oxygen product from the plant, the oxygen is pumped up to the required pressure while in the liquid state by a relatively small, efficient centrifugal pump. Then the oxygen is vaporized in the smaller heat exchanger, recovering its refrigeration. The gas is delivered from the plant as a warm, bone-dry, gaseous product at high pressure.

"Sandwich"-Rolling Process

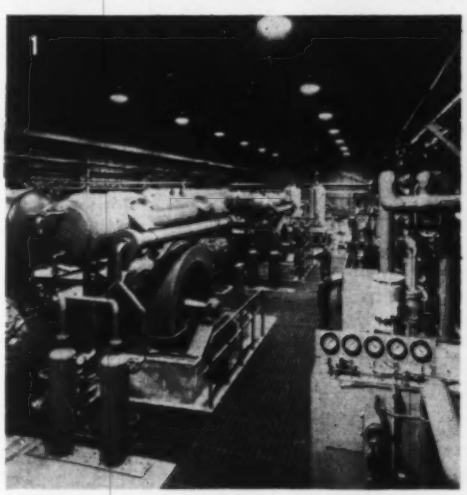
A SANDWICH-rolling process developed by Howard S. Orr, United States Steel Corporation development engineer, produces steel sheets up to 90 in. wide—nearly twice the width of light-gage stainless and alloy sheets now being made by conventional methods.

These and even wider sheets may become available. As a result of this pioneering effort by U. S. Steel, the over-all weight of aircraft and missiles can be reduced by eliminating many of the joints and seams now necessary in the fabrication of airframe parts and skins from narrower sheets. At the same time, the advantages of stainless and alloy steels—strength, toughness, and resistance to heat and corrosion—will be retained.

The new method consists of sandwiching stainless or alloy-steel plates between two heavier plates of ordinary carbon steel, closing the assembly with welded-in side and end bars, and—after heating—rolling the sandwich. After cooling, the ends and sides of the flattened sandwich are cut away, and the carbon-steel cover plates removed to free the wide, thin sheets inside for removal and use.

A typical experimental sandwich rolled at U. S. Steel's Homestead District Works contained four 12 per cent chromium stainless plates, each $^{5}/_{16}$ in. thick. These were enclosed in 1-in-thick carbon-steel cover plates, so that the assembly, after welding, was about 3 in. thick. This was reduced in rolling to $^{3}/_{8}$-in. thickness with a width of 100 in. and a length of 250 in., a reduction of about 90 per cent. This reduction was effected in each component, so that the original stainless plates were reduced to a nominal thickness of 0.033 in., width was 90 in., and length 230 in.

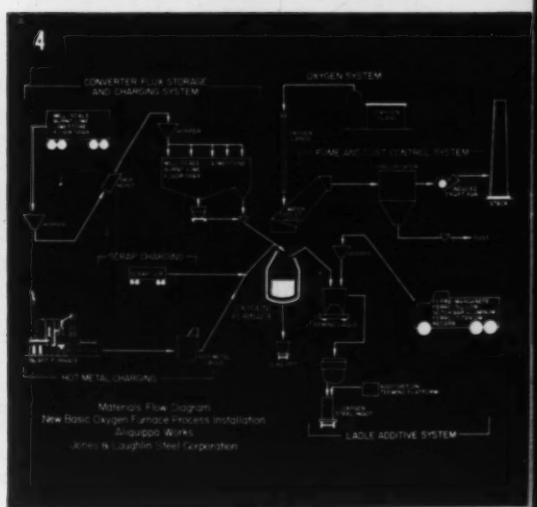
Contributing to the significance of the results achieved to date is the fact that existing rolling mills have been used. Since the sandwiches have the working characteristics of the carbon-steel cover plates rather than the contents, no revamping of rolling mills is needed to supply more power or stiffen the rolls.



1
Compressor room and control center of the new oxygen facility. Two plants produce over 230 tons per day of 99.5 per cent pure oxygen. High-pressure liquid-oxygen pumps are shown, near right.

2
Hot metal is transported from the blast furnaces to the new basic-oxygen furnace and charged directly into the new facility. The charge for the new-type furnace is made up of scrap, hot metal, and other materials.

3
Quality of each heat from the new basic-oxygen furnace process is carefully controlled. Here, metallurgists prepare to take a sample from the furnace. Samples are taken before each heat is poured from the furnace.



4
Materials-flow diagram of the new basic-oxygen furnace process installation at the Aliquippa Works of Jones and Laughlin Steel Corporation. The oxygen plant is an important auxiliary to the system.

Intricate parts with properties comparable to machine-wrought parts are possible with a new powder-metallurgy process called Steelmet

Powder-Metallurgy Process

A POWDER-METALLURGY process which makes it possible to produce intricate parts with properties comparable to machine-wrought parts has been developed by P. R. Mallory & Company, Inc., at the Indianapolis, Ind., plant.

Powder metallurgy has been under development since the 1940's, but high density parts with good physical properties were difficult to produce.

From approximately 2000 tons in 1946, production of powdered metals was expected to reach 40,000 tons in 1957. Aware of the potential, and recognizing the problems, P. R. Mallory engineers inaugurated a research project in 1952. The company had an extensive background in powdered metals, especially with Mallory 1000, a powdered tungsten alloy which has many unusual applications. Extreme density plus high strength led to its use for aircraft gyroscope rotors, control balance weights in guided missiles, counterbalances in automatically wound wrist watches, and radioactive shielding.

First step was an investigation of the basic properties of powdered raw materials. Using cheap commercial iron powders as starting materials, Mallory researchers successfully worked out an entirely new process for producing iron-alloy powders.

The process called Steelmet eliminates the many special and more expensive techniques such as copper infiltration, multiple pressing and sintering, and hot pressing usually required to produce high-density parts.

With this new process, Mallory is able to produce a multitude of iron and steel compositions. From these, it is possible to produce intricate parts such as gears, cams, levers, pawls, ratchets, with properties comparable to machined-wrought parts—an achievement previously impossible with conventional powder-metallurgy processes.

Steelmet parts, according to the company, will ultimately be used by a cross section of U. S. industry including automotive, aircraft, ordnance, electrical appliance, and business machines. To evaluate commercial applications, samples have already been produced for a number of companies in Mallory's pilot plant.

The industrial and military significance of this development is evident when one realizes that it may take 18 months to tool and produce a small intricate part for a weapons system by present conventional wrought processes. With the Steelmet process, the required physical properties can be produced by powder metallurgy at a fraction of the time and cost.

The company was the recipient of the 1957 Industrial Science Achievement Award from the American Association for the Advancement of Science for the contribution to metallurgy represented by the development.

New Computer

THE University of California at Los Angeles' Western Data Processing Center has been selected for the first installation of an IBM 709 Electronic Data Processing Machine. Use of the $4-million machine is being given to the University by the International Business Machines Corporation without charge.

The first of a new generation of large-scale computers, the 709 can make up to 2.4 million "decisions" per minute in terms of true and false answers, can memorize over 1 million bits of information, and can read, write, and compute simultaneously. Any word in the computer's memory can be located and made ready for use in only 12 millionths of a second.

Machine-Construction Kit

A UNIQUE machine-construction kit which enables engineers or machine designers to make precision working models of practically any type of machine, drive, or mechanism is available from FAC Division of Overseas Commodex Corporation, Detroit, Mich. FAC models have such ruggedness, precision, and long-wear-life properties that they can be used as breadboard models and test equipment for research and development work.

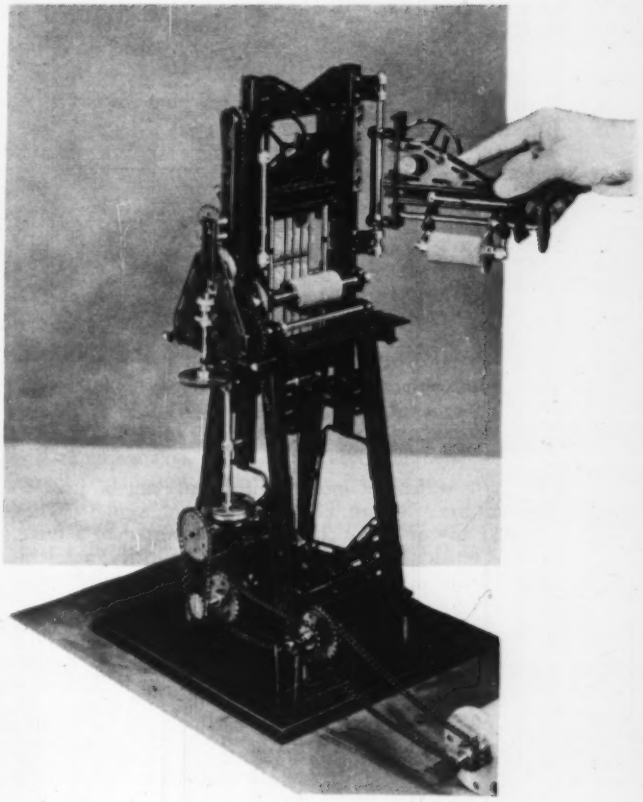
The system uses a basic construction concept of round rods and beams that are assembled by rugged clamping.

A wide variety of precision-machined mechanical components such as ball bearings; spur, bevel, internal, and worm gears; gear racks, ratchets; sprockets; pulleys; sheaves; couplings; springs; wheels; disks, and universal joints are utilized.

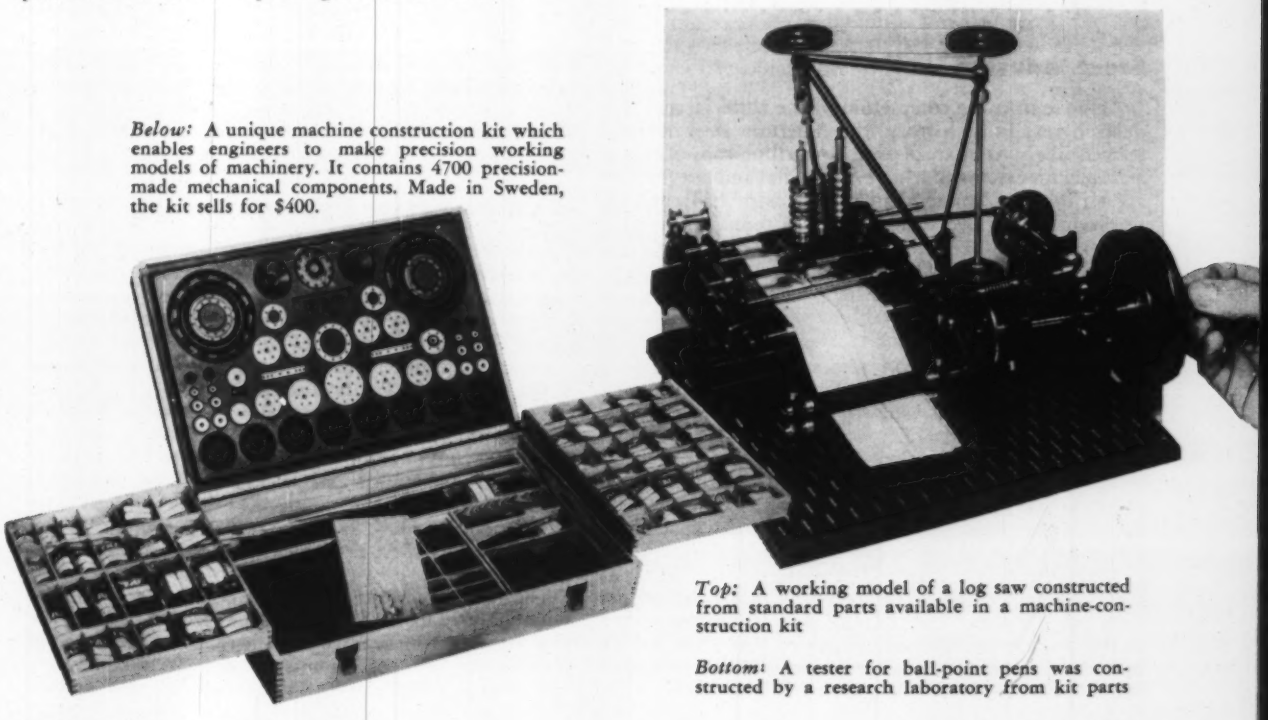
The FAC construction system was created by Mark Sylwan, a Swedish inventor, to provide an accurate method of constructing and proving machines and mechanisms that would avoid large development-program expenditures on machines whose principles had not been thoroughly substantiated. The name "FAC" is from the Latin word meaning to "make" or "do."

Models of huge log saws, traveling cranes, articulated rail cars, and rotary printing presses have been made by industrial concerns to prove designs before blueprints were finalized and construction started. One research laboratory made a tester for ball-point pens.

The kits are made in two sizes. One which sells for $250 has 2700 parts, and is intended for student engineers as well as professionals. The larger kit sells for $400 and has 4700 parts specially selected to meet industrial machine design and development requirements. Extra parts are available for expanding these basic kits.

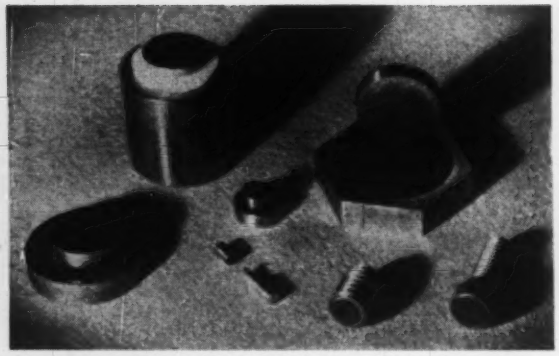


Below: **A unique machine construction kit which enables engineers to make precision working models of machinery. It contains 4700 precision-made mechanical components. Made in Sweden, the kit sells for $400.**

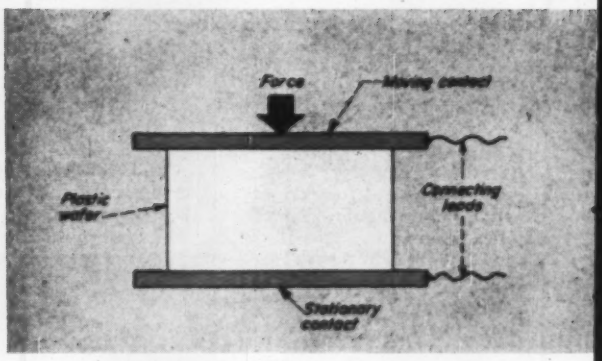


Top: **A working model of a log saw constructed from standard parts available in a machine-construction kit**

Bottom: **A tester for ball-point pens was constructed by a research laboratory from kit parts**



Plastic wafers of intermetallic resin measure force



Sandwich type is one form of pressure cell

Pressure Cells

PLASTIC wafers of intermetallic resin can be used to convert force to an electrical control signal. They react to any quantity that can be converted to a force, such as tension, strain, displacement, velocity, acceleration, vibration, or rotation. The range is from less than 0.001 gram to shock ratings of 250,000 psi for explosives.

An article in *Product Engineering* by Dudley B. Clark, director of Clark Electronic Laboratories, Palm Springs, Calif., describes their construction and characteristics.

The pressure cells make use of the fact that resins, produced by processing rare earths with zirconium tetrachloride, undergo a major change in electrical resistance when compressed. The cells are made by bonding a long-lived plastic pellet or wafer to a recess in brass or stainless steel.

High output as well as high sensitivity eliminate the need for amplifiers when operating relays, recording instruments, or other controls.

Construction is simple, merely two electrical-contact surfaces with the sensitive material between them. One all-plastic cell requires no metal contacts.

More than 27 compositions of sensitized plastic have been developed for over 300 types of standard cells. The lower limit to size is the minimum area on which a load can be applied—0.001 sq mm—and there is no upper limit. Change in resistance with load, and maximum resistance are regulated by a heat-treating process used during manufacture.

Compression in operation is very slight, being only 0.007 in. at full load for a 10,000-psi cell. Since there are no moving parts, vibration and shock are easily withstood. With proper design and initial processing,

Steel Industry

APPROACHING the completion of the third largest production year in its history, the American steel industry seemed likely to produce over 114 million tons of ingots and steel for castings during 1957. That amount is about six million tons more than the industry had capacity to produce only five years ago. The tonnage compares with the record 117 million tons produced during 1955, and with 115.2 million tons in 1956.

Records are indicated in steelworkers' earnings; in blast-furnace output; in shipments of several major finished products, according to *Steel Facts*.

Operating average for steelmaking furnaces will be about 85 per cent of their Jan. 1, 1957, capacity of 133,459,150 net tons annually. That is about the same as the percentage rate of operations in 1952. However, the 1957 production estimate is more than 21 million tons greater than for 1956. The reason lies in the fact that steelmaking capacity for 1957 was nearly 24.9 million tons greater than the 1952 capacity of 108,587,670 tons.

All factors pointed to 1957 as a record year in blast-furnace output with an estimated 81 to 82 million net tons of pig iron and ferroalloys. That constituted nearly a four-million-ton increase over the former record of 77.8 million tons set during 1955. It compared with nearly 76 million net tons made in 1956. The 1957 rate of operations for blast furnaces may be 94 per cent of capacity, compared with 88.9 per cent in 1956, and 92.6 per cent during the previous record year of 1955.

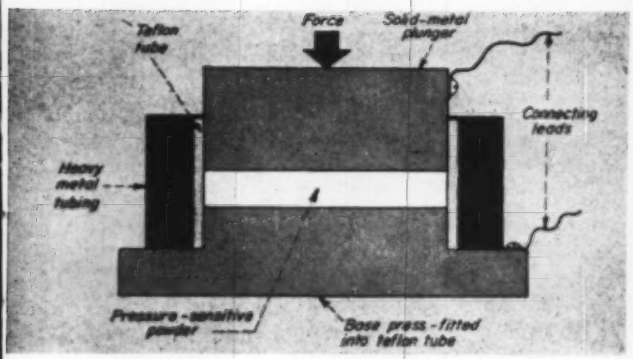
Wind Tunnel for Dynamic Testing

SHAKEDOWN and calibration tests are under way at Case Institute of Technology, Cleveland, Ohio, on a new supersonic wind tunnel which provides a unique facility for supersonic-flow and rocket-instrument testing under accelerated flight conditions.

Called a "transient Mach number" wind tunnel, the device permits aeronautical scientists to vary the operating conditions in the test section over the range of Mach numbers from 1.2 to 2.8 in four seconds. It is the only complete wind tunnel which can be used to test working models of rocket instruments and other devices under dynamical conditions simulating those which exist during acceleration. So far, no other method for testing the accuracy of these instruments under flight conditions has been devised.

The Mach number, used to gage the velocity of the wind in the tunnel, is based upon the speed of sound at the existing operating condition in the tunnel. The speed of sound at sea-level condition is approximately 1200 fps.

The unique flexibility of the tunnel depends upon a



Pressure-sensitive powder is used in another type

limited tensile strength which can be readily overcome.

Either a-c or d-c voltages from 500 volts to millivolts can be applied. The upper limit is primarily the result of the decrease in sensitivity which occurs with heating above allowable cell temperatures—300 F for standard cells, 600 F for those with special processing. Cells may also be connected in parallel or in series. Dynamic response is generally limited to approximately 60 cycles, but can be increased to 400 cps or higher with special processing.

The pressure cells may be used for measuring hydraulic or wind-tunnel pressures, pressures on the surfaces of gas-lubricated bearings, or on aircraft-propeller blades, to cite a few examples. They can be applied to the control of sorting by weight, to the regulation of engine speed, ball-bearing preloading, or various process pressures and tensions.

nozzle and diffuser which can open or close rapidly to change the velocity of the air. Variable-geometry nozzles and diffusers are not uncommon, but usually changes can only be made slowly or while the system is not in operation. A free-jet transient Mach number nozzle has also been used before, but a complete nozzle, test section, and diffuser installation is unique. Made of complex-shaped stainless-steel plates, the nozzle maintains correct geometrical relationships to very precise tolerances at all positions in order to insure proper shock cancellations.

Simultaneously with Mach number changes, the attitude of the model in the tunnel can be changed rapidly if desired.

In addition to testing rocket instruments, the tunnel can also be used to study the flow of air through the intakes of ramjet engines under conditions of rapid acceleration or deceleration, as well as for more conventional steady-state high-velocity aerodynamics problems.

The tunnel itself is made of some 5000 lb of stainless steel, with test-section dimensions of 5 × 5 in. It is 18 ft long exclusive of the air-supply and evacuation lines. An installed electrical capacity of 900 hp provides the energy source for the drive motors. The centrifugal compressor at steady speed operates at 20,000 rpm.

Heat generated by the operation is removed through a system of heat exchangers that can remove the equivalent of 600 hp of heat from the system. The air itself enters the wind tunnel at 350 deg after leaving the compressor. When the velocity of the air in the tunnel is changed, a system of bypass pipes and ducts "fools" the compressor, so that it continues to run at essentially steady conditions.

Automatic pressure and temperature controls maintain a preselected air density into the compressor. Construction of the nozzle, test section, and diffuser components was by Amrad, Inc., of Sewanee, Tenn.

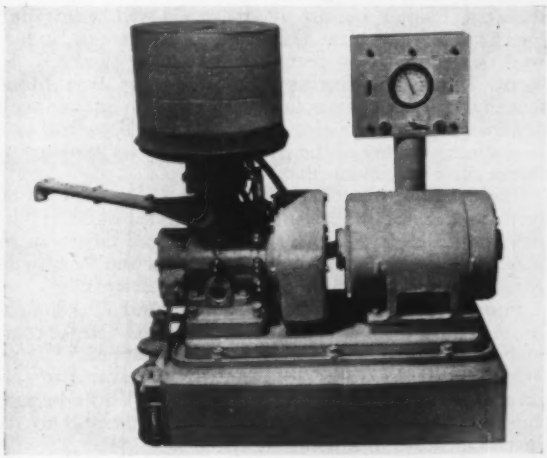
Gas Liquefaction

MANY processes require temperatures that range from −100 to −200 C (−148 to −328 F), and most research laboratories and plants must keep liquid gases on hand. A gas liquefier only 37 in. long, 20 in. wide, and 34 in. high that produces approximately 5 quarts of liquid air per hr is made by the Instruments Division of North American Philips Company, Inc., Mount Vernon, N. Y.

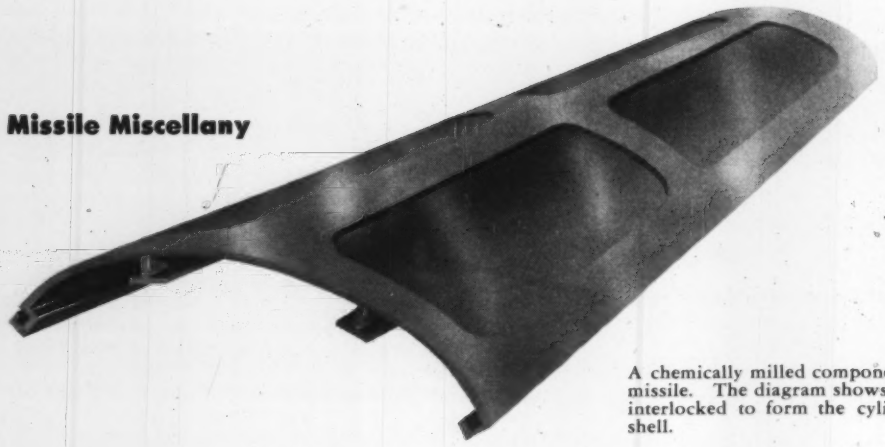
The unit makes use of the gas-refrigeration cycle in a novel way, using helium as the refrigerant. In operation, the helium is compressed in a chamber surrounded by a water jacket. The gas at constant volume then passes through a regenerator where it gives up more heat, then it goes to an expansion chamber where volume increases, thus lowering temperature. Without decreasing volume, the helium is then moved back through the regenerator to the compression chamber where the cycle begins again.

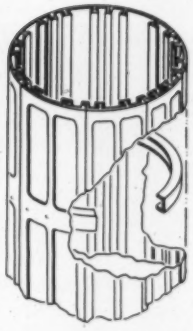
Air or gas to be liquefied does not pass through the internal mechanism of the machine. Instead, it enters a chamber surrounding the cylinder at normal atmospheric pressure, condensing on the cold surface of the head until the quantity is large enough to be run off. The system provides an oil-free high-purity product. If desired, selected gases or vapors can be passed over the head and liquefied. The process also permits much lower temperatures than those obtained with machines operating on the evaporation principle where the lowest economically obtainable temperatures are between −76 and −112 F.

The Norelco Gas Liquefier produces liquid air or liquefies selected gas or vapors without compression, permitting production on the site without storage or transportation loss



Missile Miscellany





A chemically milled component of a missile. The diagram shows panels interlocked to form the cylindrical shell.

▶ Chemical Milling of Missile Structures

Panels, 3 ft wide and over 25 ft long, are being chemically milled to exact tolerances of ±0.003 in. by United States Chemical Milling Corporation, Manhattan Beach, Calif., for use in missile structures.

Eight of these panels are interlocked to form a cylindrical shell used for the body of a long-range ballistic missile which also serves as the exterior of the fuel and oxidizer tanks in some applications. Several bulkhead rings, which are also chemically milled, are used to give the shell additional structural rigidity.

With chemical milling it is now possible to produce almost any shape or contour from titanium and super-steel alloys which are extremely difficult to form and machine in a conventional manner.

With each pound of unnessary weight removed from a missile, approximately 18,000 ft of additional altitude and an extended increase in range can be gained by the vehicle.

▶ Missile Master

Missile Master, the first fully operational electronic air-defense control system in the United States, is in operation at Fort George G. Meade, Md. Missile Master will help defend the Washington-Baltimore government-industry complex against air attack and will be installed for the defense of New York and other strategic, industrial, and population centers. Developed by the U. S. Army Signal Engineering Laboratories at Fort Monmouth, N. J., in conjunction with The Martin Company of Orlando, Fla., the electronic system will control and co-ordinate the fire of the Army's air-defense weapons to insure their maximum effectiveness.

Target can be selected economically and quickly, with control of each Nike missile being retained by local battery commanders. In this way, preselected targets in an attacking air fleet are assigned for destruction by Missile Master in individual batteries of a Nike network.

Formerly, antiaircraft batteries were controlled and co-ordinated by voice telephone from a central defense command post where targets were manually mapped.

Missile Master stores electronically all information on targets in the area and presents it on a TV-like picture tube in a simplified form. This is in addition to its instantaneous-transmission function.

Although Missile Master operates independently, it can co-ordinate the fire of Nike batteries in co-operation with the U. S. Air Force SAGE interceptor-aircraft control system in the over-all defense of the continental U. S.

▶ Vanguard's Plastic Nose

When the Vanguard rocket launches America's first satellite into outer space, the nose cone, which is approximately $6\frac{1}{2}$ ft long and 30 in. in diam at the base, will be made of a new plastic phenolic developed by the Reinforced Plastic Department of Raybestos-Manhattan, Inc., Manheim, Pa. It will be tipped with a point of solid titanium.

The function of the nose cone is to streamline the rocket and insulate the enclosed satellite from friction-generated heat encountered in the high-speed upward flight which will reach an altitude of 300 miles and a speed around 18,000 mph. The nose cone will also protect the 72-ft-long rocket from ram effect due to aerodynamic loading, the forces acting on the rocket while it is in motion through the air.

The cone material is an asbestos-reinforced plastic identified as Pyrotex felt style 41-RPD, selected for its high strength-to-weight ratio, extremely high modulus of elasticity at low and elevated temperatures, and resistance to blistering, delamination, and erosion when subjected to high temperature and thermal shock. The cone is molded by The Martin Company in two parts so it can split apart and drop off when the rocket is above the densest part of the atmosphere.

▶ Phenomenal Heat Problems

Rocket-powered missiles will present phenomenal heat problems, particularly where associated with the re-entry portions of ballistic missiles. Concerning this problem, Frederick L. Bagby, Jr., an aerodynamics and flight-propulsion expert at Battelle Memorial Institute, Columbus, Ohio, writing in the *Battelle Technical Review* and in *Astronautics*, states: "Depending upon their kinetic energy and flight path, temperatures from 2000 to over 15,000 F may exist in a boundary or shock layer." In new propulsion devices, such as the so-called "plasma jets" employing ionized light gases, and in vehicles using solar heat, the estimated temperatures may range from 3000 to 20,000 F.

Army Ballistic Missile Agency personnel at the Redstone Arsenal, Huntsville, Ala., unpack an engine for the Redstone missile

Beyond this, there is still another possible propulsion system, known as the Photon system, which may bring temperatures in excess of 100,000,000 F, representing "physical conditions completely beyond the scope of current propulsion technology."

Rates of heat transfer, total quantities of heat involved, and chemical reactions associated with high temperature are also major problems.

▶ Digital Computer for Missiles

The first digital computer reported to be fast enough to evaluate the performance of a missile in full flight was introduced by the Packard-Bell Computer Corporation at the recent 7th Annual Eastern Joint Computer Conference and Exhibition in Washington, D. C.

The new computer developed for the U. S. Army Ordnance Ballistic Missile Agency at Redstone Arsenal is known as TRICE, for "transistorized real time incremental computer, expandable."

The evaluation of dynamic systems, such as those involved in the control of missiles, previously has been performed by analog computers inasmuch as digital computers, although more accurate, have been too slow.

TRICE, which is only for missile applications and not general-purpose computation, can solve a complete set of equations every 0.0001 sec. This is 24 times faster than other digital computers, the fastest of which can perform only a single multiplication operation every 240 microsec.

▶ 75,000-Lb Thrust Rocket Engine

More than 75,000 lb of thrust is developed by the liquid-propellant rocket engine in production by Rocketdyne, a division of North American Aviation, Inc., for the Army mid-range Redstone missile. A rugged, single-chambered system, the engine develops its thrust through the combustion of liquid oxygen and alcohol.

Only 10 ft 11 in. long, and 5 ft 10 in. in diam, the latest model of the engine weighs less than 1450 lb. Its propellants are pumped concurrently by the engine's 780-hp turbopump. A single turbine is driven by high-velocity steam developed through the decomposition of hydrogen peroxide in a midget generator light enough to be held in one hand.

The engine withstands combustion temperatures in excess of 5000 F by circulating fuel between the thin double walls of its thrust chamber. The fuel passes through the chamber before being injected and burned with liquid oxygen.

The pioneering engine, in production since 1952, was advanced to its current performance level through progressive design refinements. The sixth model of the series currently is being delivered to the Army and Chrysler Corporation, manufacturers of the missile.

The first rocket engine with thrust greater than 50,000 lb to be placed in U. S. production, the Redstone system was designed for combat reliability, and production by conventional manufacturing methods.

Nuclear Briefs

▶ Army Closed-Cycle Gas Turbine

GROUND has been broken at the U. S. Army Engineer Research and Development Laboratories, Fort Belvoir, Va., for the first closed-cycle gas-turbine test facility in the United States. Information gained from the operation of this facility will be combined with experimental results and operating experience to be gained from the AEC Gas Cooled Reactor Experiment to form the basis for design of a mobile gas-cooled nuclear power plant for military applications. The Gas Cooled Reactor Experiment project is now in the design and component-development stage.

Conceptual and engineering designs for the test facility were made by the firm of Sanderson and Porter, New York, N. Y. The system will be built by Aerojet-General of Azusa, Calif. The Stratos Division of Fairchild Engine and Aircraft Corporation, Bay Shore, N. Y., is fabricating the turbocompressor.

The system will operate on a regenerating closed cycle with nitrogen as the working fluid. An oil-fired heater will be substituted for the reactor as the heat source in this test facility. The nitrogen is heated to over 1000 F in the heater and expanded through a two-stage, axial-flow turbine. The turbine, in turn, acts to drive a two-stage centrifugal-flow nitrogen compressor and an electrical generator which produces electric power. The power will be dissipated through an immersion heater located outside the building.

Fort Belvoir is already the site of the U. S. Army's first nuclear power plant—the Army Package Power Reactor.

▶ 12.5 Bev Proton Synchrotron

Argonne National Laboratory has received authorization from the AEC to proceed with design studies for a 12.5 Bev zero-gradient proton synchrotron. The facility will cover about 60 acres of the 3700-acre main-laboratory grounds in Lemont, Ill. Cost is estimated at $27 million.

The new Argonne machine will produce greater numbers of accelerated particles than any other of the multi-billion-electron-volt accelerators now in operation or under construction anywhere in the world. It will be an important tool for basic research on nuclear structure and reactions.

▶ Uranium Mining and Refining

According to the Atomic Industrial Forum's summary of nuclear progress, seven companies signed contracts for the sale of uranium concentrates to the AEC in 1957, under which they will construct uranium mills in the U. S., and six companies continued the construction of mills begun in previous years. These were in addition to 11 privately owned mills previously in operation.

Upon completion, these 24 facilities will have a combined total milling capacity of 20,420 tons of uranium ore per day, and will represent a total investment of more than $132 million.

At the end of 1957 the U. S. was producing uranium concentrates at the rate of about 10,000 tons per yr. Total U. S. reserves of measured, indicated, and inferred uranium ore were estimated at 67 million tons with an average uranium-oxide content of 0.27 per cent.

▶ Homogeneous Reactor Experiment No. 2

The Homogeneous Reactor Experiment No. 2 went critical at the Oak Ridge National Laboratory on December 27, becoming the sixth power-producing or power prototype reactor to go into operation in the U. S. during 1957. The reactor was also one of the five original types chosen by the AEC for development.

▶ EBR-I Operates With New Core

Experimental Breeder Reactor I, located at the Idaho Division of Argonne National Laboratory, achieved criticality in November after the installation of a new Mark III core.

The new core is designed so that mechanical motions are rigidly controlled to prevent bowing of the fuel rods. The Mark III design covers two of the main parts of the EBR-I structure—the core and inner blanket. These sections are contained in a double-wall tank called the inner tank assembly. Mark III is 9 ft 5 in. long. The outer wall is constructed of laminated steel disks. The assembly is NaK-cooled.

The third major portion of EBR-I, an outer air-cooled breeding blanket of natural uranium, remains unchanged.

Materials Briefs

▶ Outdoor Exposure of Plastics

A GUIDE to Ordnance Corps engineers in the selection of plastics for use in outdoor exposure has been released for industry. Weather-resistance data for 72 commercially available plastic materials were accumulated, together with information on the effect of additives, fillers, and other modifiers. The materials were grouped as thermoplastics, thermosets, cellulosics, laminates, and elastomers.

A detailed formulation of each material, the conditions of its fabrication, a statement of its special properties, and applicable Government specifications are presented. The plastics are rated according to long-term resistance, good short-term resistance, poor resistance, and resistance dependent on modifiers. Experimental results of tests on each material—fabrication of specimens, apportionment, exposure, and so forth—are also included.

The 268-page report by R. B. Barrett of Picatinny Arsenal, entitled "Resistance of Plastics to Outdoor Exposure," and dated February, 1955, is available on order number PB 131331 from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., for $6.

▶ Extremely Small Permanent Magnets

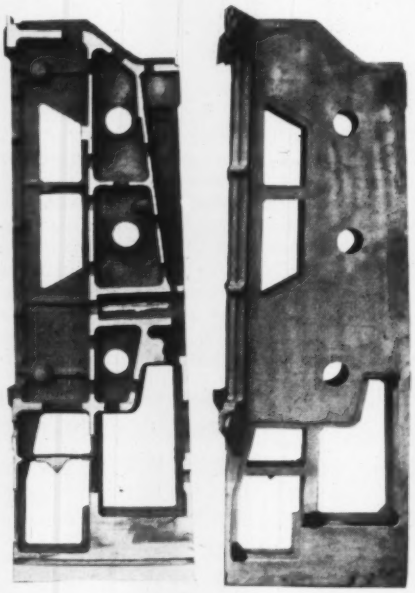
Permanent magnets as small in diameter as a human hair have been made from Cunife at the National Bureau of Standards. Cunife is an alloy of approximately 60 per cent copper, 20 per cent nickel, and 20 per cent iron with an unusual combination of magnetic and mechanical properties. Instead of requiring casting or sintering into a desired shape like most highly coercive magnet materials, Cunife can be cold drawn. This ductility suggested its use for very small magnets.

▶ Aluminum Alloy Castings Replace Forgings

A new high-strength aluminum alloy, Tens-50, is being cast into pylons for North American Aviation's F-100 Super Sabre by Rayson Casting and Manufacturing Company, Gardena, Calif. Castings in the alloy developed by North American Aviation's Los Angeles Division are replacing forgings.

Another F-100 part, which formerly cost $350 to mill from bar stock, is being cast for approximately $15 and has the same weight-to-strength ratio.

Quantity production of the F-100 pylon castings is being achieved with an x-ray rejection rate of less than 1 per cent.



Less than 1 per cent x-ray rejection rate has been achieved by Rayson Casting and Manufacturing Company with this complicated casting. This North American Aviation pylon is being cast in the new Tens-50 aluminum-casting alloy. It has a higher strength-to-weight ratio than conventional alloys.

▶ Thermal Properties of Selected Plastic Materials

Thermal properties of a selected group of plastic laminates, cores, and sandwich panels measured by Southern Research Institute for the Air Force's Wright Air Development Center have been released for industry. Properties measured included specific heat from 100 to 600 F, thermal conductivity, and coefficient of linear thermal expansion from −100 to 600 F. The test materials were four laminates with 181 glass-fabric reinforcements but with four different resins: three $^1/_2$-in-thick foamed-in-place alkyd-isocyanate plastic cores; one $^1/_2$-in-thick foamed-in-place heat-resistant plastic core; one foam sandwich panel; and one honeycomb panel.

Thermal properties of laminates were compared with those of laminates tested in the first part of the research, the report of which has not been released for publication. Foam cores, except the heat-resistant core, decomposed at relatively low temperatures. In addition, the low densities of the core materials gave less precision in the specific-heat determinations.

The 79-page report by F. R. O'Brien and S. Ogleby, Jr., entitled "Investigation of Thermal Properties of Plastic Laminates, Cores, and Sandwich Panels—Part 2," and dated November, 1955, is available on order number PB 121191 from OTS, Department of Commerce, Washington 25, D. C., for $2.

▶ Fluoro-Chemical Coolants for Transformers

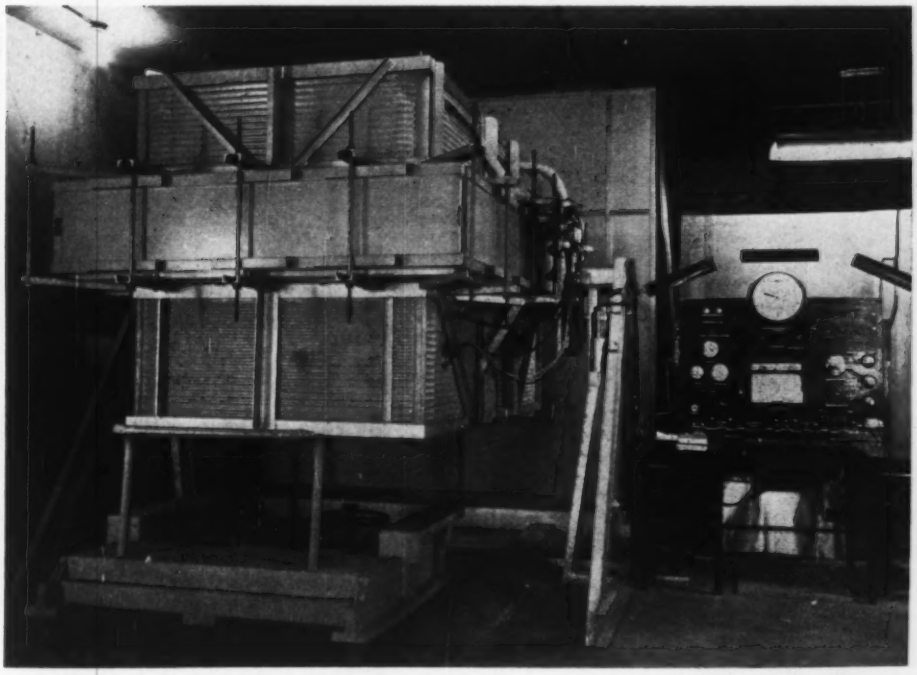
A class of materials known as perfluorinated compounds made by Minnesota Mining and Manufacturing Company, St. Paul, Minn., has made possible reductions in size and weight as great as 75 per cent in electronic-type transformers designed by Raytheon Manufacturing Company, Waltham, Mass.

In the form of inert liquids and gases, these compounds have been used by Raytheon as coolants in transformers built to operate at temperatures up to 200 C. Such coolants have electrical properties on a par with those of the transformer oils which are used at lower temperatures.

▶ Thermal Insulation With Reflective Surfaces

Building-materials research at the National Bureau of Standards has shown that air spaces in buildings give much better insulation if they are surfaced on one side, or subdivided, with highly reflective surfaces such as aluminum foil. Moreover, the use of reflective surfaces on typical fibrous insulating materials of blanket, batt, or board form installed with adjoining air spaces increases materially their insulating effect, especially where the direction of heat flow is downward. The investigation was carried out in co-operation with the Aluminum Company of America by H. E. Robinson and F. J. Powell of the Bureau's heat-transfer laboratory, and L. A. Cosgrove of Alcoa's research fellowship at the Bureau.

The results of the experiments have been published as: Robinson, H. E., Cosgrove, L. A., and Powell, F. J., "Thermal Resistance of Air Spaces and Fibrous Insulations Bounded by Reflective Surfaces," BMS 151, and are available for 15 cents from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.; and "The Thermal Insulating Value of Air Spaces," Housing Research Paper 32, available from the same source for 25 cents.



Rotatable guarded-hotbox apparatus used in thermal-insulation studies at NBS. Control console is at *right*.

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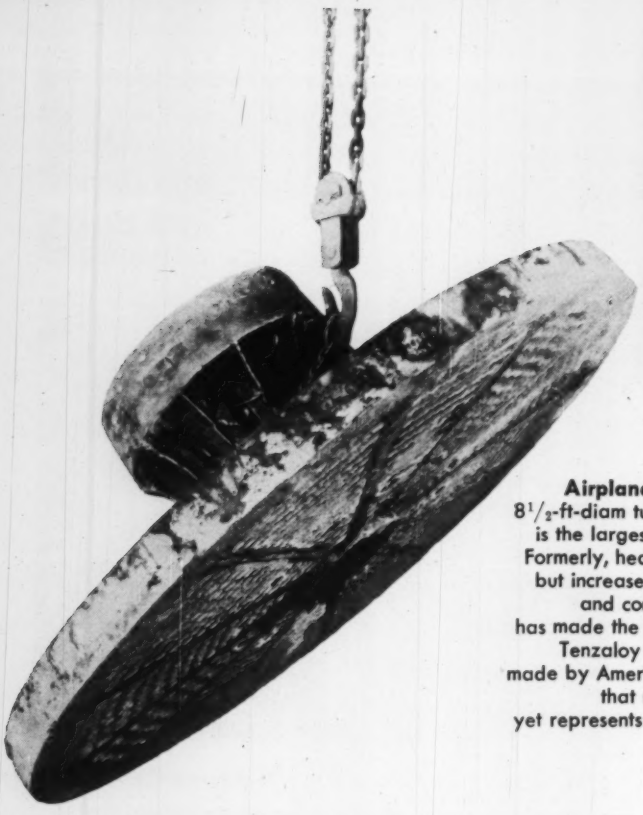

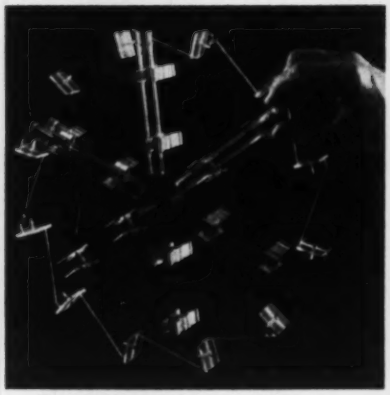

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Airplane Turntable. This 4000-lb $8\frac{1}{2}$-ft-diam turntable for airplane testing is the largest ever made from Tenzaloy metal. Formerly, heat-treated 356 aluminum was used, but increase in the size and weight of planes, and consequently turntable castings, has made the cost of heat-treating too expensive. Tenzaloy is a less costly self-aging alloy made by American Smelting and Refining Company that requires no heat-treatment yet represents no sacrifice of desirable properties.

1 Midget Submarine. The U. S. Navy's first 50-ft 25-ton submarine, manned by a crew of four, was designed and built by Fairchild Engine and Airplane Corporation. The engine, made by Hercules Motor Corporation, Canton, Ohio, was adapted for underwater propulsion from a production unit similar to those for standard marine craft.

2 Lead-Brick Wall. A 2-in-thick wall of 15-lb lead bricks will help contain radiation from Westinghouse Electric Corporation's new laboratory "hot cell." The top surface of each brick is curved to prevent radiation through flat joints. Additional protection will be afforded by 16 in. of steel shot between two $^1/_4$-in-thick steel walls.

3 Compression Fittings. Nylon compression fittings, installed without reaming, tapping, flaring, or wrench turning—at savings up to 75 per cent over other types—provide an anticorrosive positive anchor for original or replacement components in hydraulic or pneumatic applications using brass, copper, aluminum, steel, or nylon tubing. Tests show that Presslok fittings manufactured by the Nylon Molding Corporation, Garwood, N. J., will stand pressures as high as 1200 psi.

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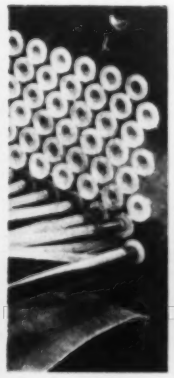

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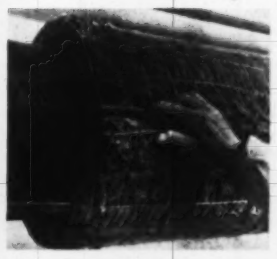
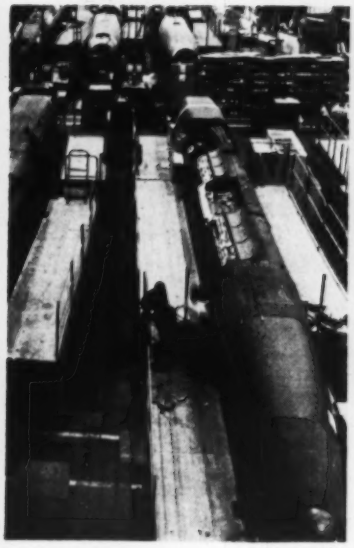
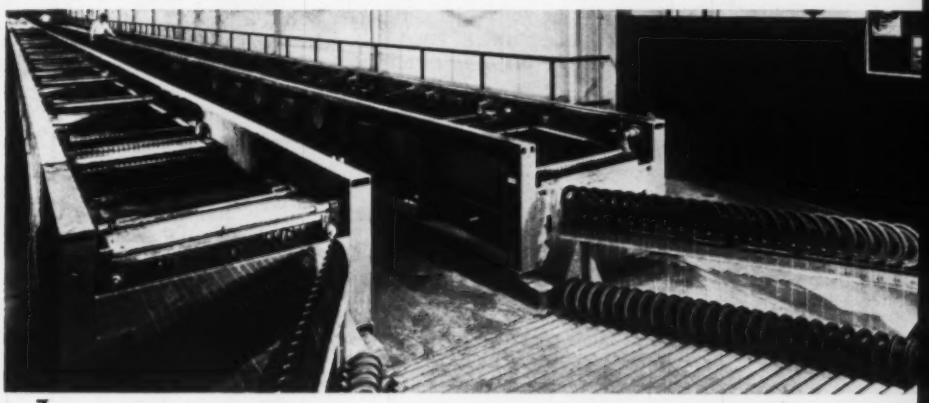


4 Built-In Tie Wires. Felted No. 101 pipe insulation made by the Baldwin-Hill Company, Trenton, N. J., is applied as quickly as more costly molded pipe coverings. Specially felted from high-temperature moisture-resistant spun mineral wool, the insulation will withstand temperatures to 1200 F. The material is fastened speedily by simply hooking built-in 16-gage wires under the opposite stay wire and bending them.

5 Water-Wheel Developing. Small quantities of exposed film enclosed in test tubes containing developer are turned on a plastic wheel by the flow of cold water used to keep the developer temperature constant. The turning wheel, used in quality-control tests at the Eastman Kodak Company, agitates the contents and insures uniform development of the film.





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6 Snark Production. The world's first intercontinental guided missile comes off the production lines of the Northrup Division of Northrop Aircraft, Inc., Hawthorne, Calif. The USAF-Northrup Snark SM-62 is a 5000-mile-range missile capable of carrying a nuclear warhead to a trans-oceanic target with extreme accuracy.

7 Continuous Copper Plating. One of two 600-ft-long "electroforming" machines at Western Electric's Baltimore, Md., plant. After cleaning and partial plating in the tanks, *left*, the 25 channels of wire reverse their direction and receive an added copper coating in a series of plating cells. Heavy-duty vertical sump pumps with all cast-stainless components below the base plate, made by the Aurora Pump Division of New York Air Brake Company, Aurora, Ill., handle the highly corrosive electrolytes.

Engineering Progress in the British Isles and Western Europe

J. FOSTER PETREE
European Correspondent

EUROPEAN SURVEY

Large Milling and Boring Machine

MACHINE tools, some of the heaviest produced in Western Germany, are those constructed by the Aktiengesellschaft Schiess, of Düsseldorf. Their FB 32/19 ram-type boring and milling machine is of interest. In this machine the boring and milling spindles have a common drive, either through a three-stage gearbox giving speeds from 1.5 to 265 rpm or by belt with one gear stage, for speeds from 50 to 650 rpm. The driving motor, of 100 hp, is controlled by a Ward-Leonard set, and a separate motor, also with a Ward-Leonard control, actuates the feeds which have an over-all ratio of 1:33.

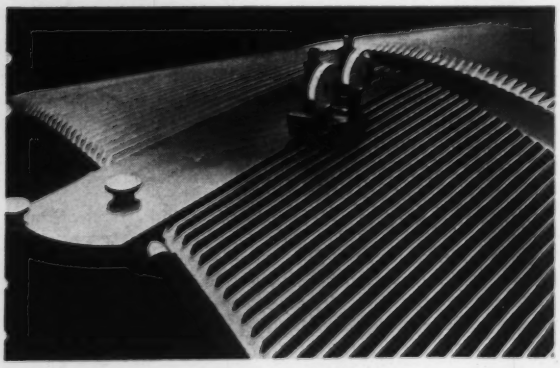
Vertical travel of the spindle head is about 13 ft 1 in. and horizontal travel of the column along the bed about 32 ft 10 in.; total boring depth, 8 ft $2^1/_2$ in.; depth bored in one pass, 5 ft 3 in.; maximum diameter bored, 4 ft 7 in.; maximum diameter faced, 7 ft 3 in.; diameter of boring spindle, $7^1/_2$ in.; diameter of milling spindle, $12\ ^5/_8$ in.; milling feeds per min and boring feeds for spindles per min, 0.079 to 71.0 in.

All the motions are regulated through electromagnetic clutches, so that every traverse can be operated electrically, either by means of switches or by using a tracer. An optical fine-measuring device, located on the platform on the head, shows the movements of the head, the column, the spindle, and the ram, and the machine is arrested automatically on the completion of any such motion. Push buttons are provided for setting and starting, and for any necessary corrections. The electronic control operates by measuring the traverse movements and the location of the working head, the measurements being shown in an optical viewer in hundredths of a millimeter. The method of operation is to break down the movements into very short distances which are measured continuously, the length of these distances being selected to suit the degree of accuracy required. Composite rectilinear motions require a number of locating

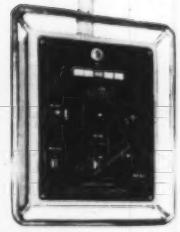
Portable Gear-Testing Instrument

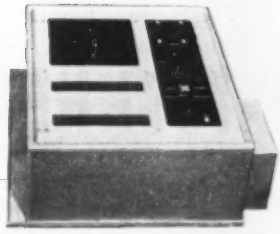
THE Swedish firm of De Lavals Angturbin (the De Laval Steam Turbine Company) of Stockholm, Sweden, has developed a new and compact instrument for testing the accuracy of large marine gear wheels. It consists of a thin flexible strip of steel, one edge of which has been scraped and stoned so as to be straight within $\pm 1\mu$ (10^{-6} meter). The strip is bent so as to make contact with the outside diameter of the wheel, to which it is attached by thin double-sided adhesive tape. The trued side of the strip then lies in a perfect helix on the periphery of the gear and provides a reference line from which the deviations of the gear can be measured by means of a dial indicator. Two opposite gear flanks can be measured without shifting the strip, thus providing a measure of the space between them and enabling pitch and cyclic errors to be determined, as well as wear of the hob during cutting. In addition, the instrument can be used to measure errors due to temperature variations, to momentary failure of the power supply to the hobbing machine, and to elastic distortion of the machine when the hob starts or finishes a cut. It provides, in fact, a check not only on the accuracy of the gears produced, but on the accuracy of the machines used to cut them.

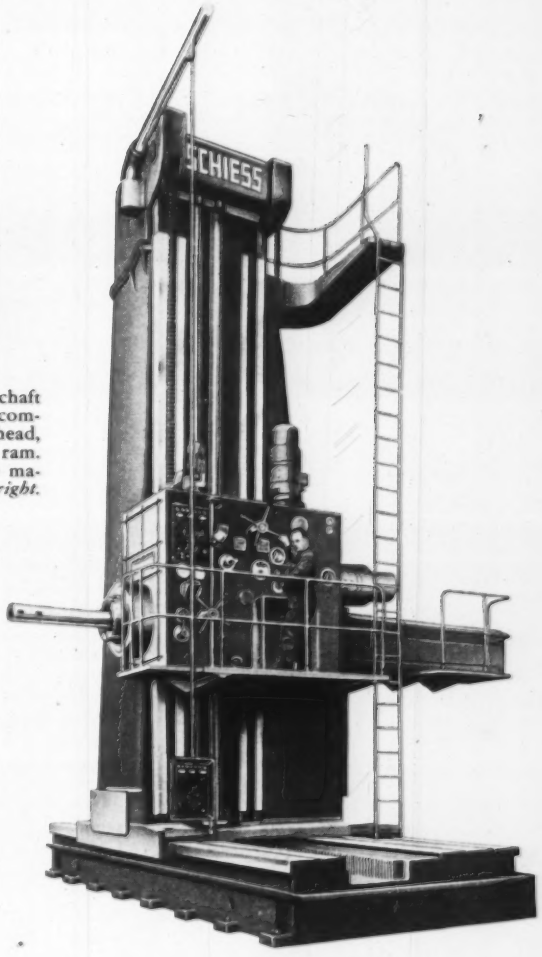
Portable gear-testing instrument checks accuracy of large marine gear wheels. Manufactured by De Lavals Angturbin, Stockholm, Sweden.



Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.







Ram-type milling and boring machine, *right*, FB 32/19, Aktiengesellschaft Schiess, Düsseldorf, Germany. Boring and milling spindles have a common drive. Optical fine measuring device, located on the platform head, shows the movement of the head, the column, the spindle, and the ram. Control system has unique feature of an illuminated diagram of the machine, *above left*. Control panel of electronic positioning device, *above right*.

values, corresponding to the distances involved, and curves need still more, the determination and selection of which can only be performed by the aid of an electronic computer with means for storing impulses. For work on single components, a program switch is incorporated which enables any one of four or eight selected operations (rapid traverse, creep speed, and so on) to be selected in any desired sequence; and there is a "functional selector" which effects such machine controls as braking, stopping, reversing, and such at any desired point. In order to determine the distance traversed in any direction there is a "memory switch" for each coordinate; when this is operated, the result of the measurement is stored up, independently of any further movements. The machine is of very robust construction. A special feature of the control system is the illuminated diagram of the machine on which the various operations can be followed. This feature is located beneath the platform of the machine.

Long-Running Thermal Precipitator for Mine Dust

THE sampling of airborne dust for scientific purposes is usually a lengthy process and therefore can be costly in manpower. To get over this difficulty, the Mining Research Establishment of the National Coal Board (the British agency which is responsible for practically all coal mining in the United Kingdom) has devised a long-running thermal precipitator which can be left to function unattended for periods up to 8 hrs. Only respirable dust is collected, and this is selected by drawing the dust-laden air through a horizontal-duct elutriator, the action of which is to remove the largest and fastest-falling particles by settlement or impingement; it simulates, in fact, the action of the human nose and upper respiratory passages. The fine particles of respirable dust then pass into the sampling head, which is a light-alloy block containing an insert of Tufnol (a laminated-paper-based plastic) supporting the heating element, a Nichrome wire held in place by springs of beryllium copper. The wire is flush with the bottom of the insert, which is supported 0.007 in. above the collecting surface, a standard microscope slide. The power supply is a miner's nickel-cadmium hand-lamp battery (though provision is made to use other types of battery if desired) and this is controlled by a rheostat to give an initial current of 1 amp.

The output can fall to 0.8 amp without affecting the precipitation. The dust-laden air is drawn into the instrument by a diaphragm pump actuated by a clockwork motor through a cam mechanism. The pump draws in 2 cu cm through the sampling head in 30 sec and expels it during the following 30 sec. The instrument case is made of steel sheet and has two compartments. One contains the battery and is secured by a magnetic lock. The other, containing the sampling head and the pump, is secured by a cylinder lock and is intended to be opened above ground only. A Perspex window in one side of the case covers an ammeter, indicating the heating-element current, a clock face to show the running time, and the clock escapement. A bubble flowmeter provides a check on the flow rate through the pump. The instrument is made by W. Ottway & Company, Ltd., Orion Works, Northfield Avenue, London, W. 13, England—probably the oldest firm of instrument makers in the world, for they have been in business, and in the hands of the same family, for over 300 years.

Substance in Brief of Papers Presented at ASME Meetings

M. ZANFARDINO
Staff Editor

ASME TECHNICAL DIGEST

Aviation

Hydraulic Component and System Consideration for High Mach Flight .....57—A-223

By F. L. Moncher, Vickers Incorporated, Detroit, Mich. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Aerodynamic characteristics and power requirements of the control surfaces of aircraft flying at high Mach numbers require complete powered control systems with no possibility for manual override in the event of power failure.

The major factors which must receive consideration in the design and development of accessory systems in general, and hydraulic systems in particular, as a result of these new needs are: Increased reliability, higher operating temperatures, and greater power to weight-and-size ratio.

In designing hydraulic systems for reliability, prevention of contamination is of great importance. Cleanliness is demanded in order to reduce the input forces necessary for control, and to minimize the wear that is generated by the contamination in the circuit.

It is impossible to eliminate contamination in a hydraulic circuit; therefore hydraulic equipment must be designed to be compatible with the expected contamination level. Contamination may be externally introduced in the circuit or be generated by the hydraulic units under their normal operating conditions.

Compatibility is accomplished by utilization of the dirt-cutting and dirt-passing ability of the various components in the system. In hydraulic pumps and motors, this condition is produced by the use of extremely hard materials or platings, such as chrome, colmonoy, or tungsten carbide to prevent wear or scoring as the particles pass between the closely fitted surfaces.

The preferred storage point for contamination is in the filters that are provided in all hydraulic circuits, and careful system design is required to insure that all of the hydraulic fluid passes through the filter during some relatively short percentage of the service life.

The generation of contamination by electric force motors, actuators, and servo valves is maintained at low levels by the use of exceptionally hard materials such as carbides and tools steels, with careful attention being paid to finishes, radii of corners, and deburring.

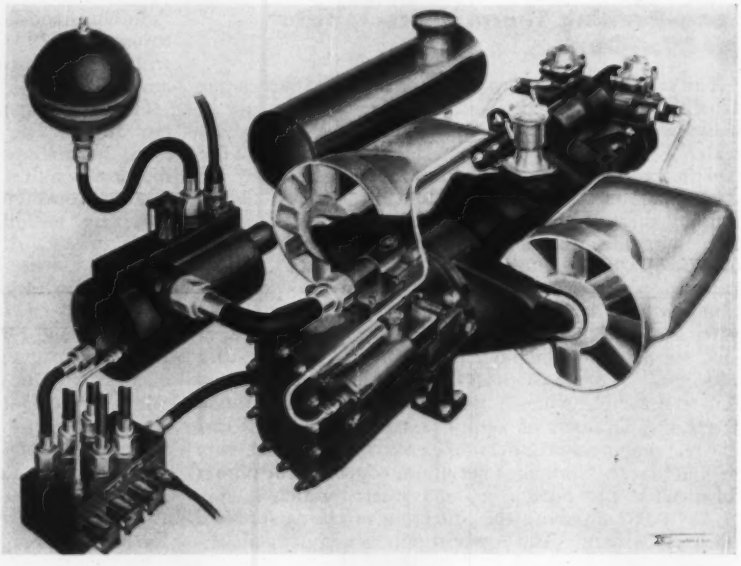
Steps taken to insure minimum contamination include: Assembly and testing in washed-air rooms that are kept antiseptically clean; minute inspection of all parts during machining and assembly to minimize the number of adhering metal particles; and careful scrutiny of assembly techniques.

Improved cleanliness of the entire unit is insured by a mechanical washing technique wherein the entire unit or major components are attached to a reciprocating device that agitates the units in the solvent. Also used is a device that alternately applies pressure and vacuum to cored passages in castings to dislodge and remove contamination that may exist. A method of contamination measurement is described as the filter-patch sample test.

Discussion is also given of the effects of high temperatures upon hydraulic equipment. In this regard, stagnation temperatures, system temperatures, a high-temperature pump, viscosity, lubricity, and stability are considered.

Military requirements of extremely high-speed flight, exceptional maneuverability, and greatly increased functions have necessitated that all equipment in an aircraft be miniaturized. A discussion of efforts to miniaturize the hydraulic components is also given.

Aircraft hydraulic-power package. Hydraulic power-generation equipment contains the pump, filters, necessary valves, accumulators, and reservoirs in one compact assembly that can be removed and replaced readily. (57—A-223)



Preparing the Ground for the Turbine Age.....57—A-283

By R. Boyd Ferris, International Air Transport Association, Montreal, P. Q., Canada. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Ground-handling techniques and equipment for turbine-powered airplanes are discussed from the point of view of the international airline operator. Problems encountered with turboprops and turbojets do not differ appreciably from those encountered in operations with piston-engined planes. The criteria which the airlines have set up to help them evaluate their ground-handling needs generally fall into the following six categories: Passenger convenience, simplicity, flexibility, speed, safety, and economy.

An idealized picture of airport facilities which satisfy each of these criteria and a more realistic examination of facilities currently in operation are presented. There are four principal types of system and each depends upon the layout of the apron and terminal buildings. The characterizing feature of each system is the type of parking to be employed: Open system, finger system, "feeding trough," and remote handling

In the feeding-trough system, airplanes are parked in a single row immediately in front of the terminal building. The open-apron system is an extension of the feeding-trough system and differs from it only in that planes are parked in more than one row near the terminal building. Long narrow enclosed corridors with one or two levels are built onto the terminal building in the finger system. Airplanes then park along both sides of these fingers. A special case of the open-apron system is the remote-handling system. Additional area is set aside at a distance of several hundred yards from the main terminal building.

The finger system is generally preferred for busy airports. This system offers the following advantages: Minimum handling and servicing times; reduction in apron congestion; good protection from weather, blast, and noise; fair flexibility; adaptability to installation of conveyer systems and bridges; facilities for "trickle loading of passengers." Principal disadvantage of this system is the additional cost of construction, maintenance, and servicing of the fingers.

Fixed servicing installations are considered and recommended for such services as fuel, electrical ground power, telephone, ground lighting, water, compressed air, air conditioning, and airplane sewage.

Facilities for load handling are another major factor in airport operation. Airplanes may be handled by taxiing, airplane conveyance, or auxiliary wheel drive. Passengers may be transported from various parts of the terminal by means of moving bridges, moving sidewalks and stairways, and passenger-carrying vehicles. Baggage and cargo present the greatest problems and to date these problems have been solved by means of conveyer systems, preloaded conveyers, mobile trucks, and so on.

Turbine Aircraft Fueling Facilities.. .....57—A-282

By R. H. Tolson, The Texas Company, New York, N. Y. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

High fuel consumption in turbine-powered aircraft increases the significance of fuel selection and the type of refueling facilities employed.

Two principal types of turbine fuel are currently being used in aircraft of the turboprop and true jet type. Kerosene, differing only slightly from the commercial grade, is the one type of fuel which many airport operators and airline officials may prefer for safety and stock-handling reasons. The other fuel for civilian turbine-powered aircraft is the wide-cut gasoline-type fuel, such as JP-4.

While the handling and storage of commercial grade kerosene have generally been considered relatively simple and safe as compared to automotive and aviation grade gasolines, contamination by low flash-point fuels must be prevented. Lowered flash point may not present a serious hazard to the operation of kerosene in a turbine-powered aircraft; however, in storage and handling, contamination may present a potential of fire and explosion beyond the realm of calculated risks. Experience with JP-4 type of fuel has shown that it provides more heat (Btu's) per gallon, and the operational advantages of the fuel at colder levels, along with the simpler problems in filtration and dehydration as well as availability of manufacturing facilities, will result in wider use of that fuel. The lower vapor pressure of the JP-4 type fuel is accompanied by the hazard of storage in bulk tanks or truck tanks, where explosive mixtures of vapor-air may exist above the fuel in the containers. The low vapor-pressure product with possible explosive vapor-air mixture above the fuel in a container introduces the possibility of ignition from static electricity which may be formed by splashing or by turbulence of the fuel during the filling operation.

Tank trucks or tenders may continue to be used for the refueling of turbine-powered aircraft as they are largely used today for refueling piston engine aircraft; however, it can be anticipated that the large quantities of fuel required to be loaded on board aircraft destined for transcontinental or overseas flights may well extend beyond the practical and economic use of tank trucks.

Fixed fueling facilities consisting of operating storage tanks, pumps for moving the liquid fuel, pipelines for carrying the fuel to the vicinity of an aircraft, terminated by equipment pits or connections flush in the pavement (commonly called hydrant systems), and utilizing mobile equipment units carrying connection and dispensing hose may come into general use in the delivery of turbine fuels to aircraft. The use of hydrant-type fueling facilities reduces the size of the mobile fuel service vehicle to that required only to handle the hose, metering, filtering, and dehydration equipment which affords high delivery rates of fuel without bulk size and without the hazard of partially empty tanks which may contain explosive vapors.

Fixed-fueling facilities employing pipe distribution systems may also terminate with equipment pits located in the pavements within the areas where aircraft are to be refueled. The pits may house air releases, strainers, meters, filters, dehydrators, as well as hose and reels, and even booster pumps, where required.

Operating storage for turbine fuel facilities should be located as close to the refueling areas as normal safe operating practices permit.

Turboshaft-Engine Development Programs to Meet Navy Helicopter Requirements.....57—A-227

By Robert Thoe, USN, Bureau of Aeronautics, Washington, D. C. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Helicopters in the future, in most cases, will be powered by turboshaft engines of the free-power turbine type. Currently, there are no turbine-powered helicopters in the United States. The Navy in co-ordination with the Army and Air Force has initiated turbine-engine development for helicopters. A complete engine-development cycle is about ten years. The environment of carriers at sea and unsurfaced airfields ashore from which the helicopter operates creates unique engine requirements.

Specific helicopter missions dictate helicopter size, performance, and operating characteristics. A list of major helicopter mission requirements illus-

trates the scope of a turbine-engine development program. Such a list follows:

1 Rotorcycle-platform or one-man machine. Requires a lightweight, small, reliable, moderate fuel-consumption engine in the 50-shp class.

2 Trainer. Requires reliability, durability, maneuverability at the expense of range, endurance, and speed. 400-shp turbine class.

3 Utility and observation. Requires maneuverability, high speed, altitude performance, and good range or endurance. 1000-shp turbine class.

4 Antisubmarine warfare helicopter. Requires flight stability, long endurance, and a considerably great amount of time at a high percentage of normal rated power. 2000 to 3000-shp turbine class or equivalent.

5 Minesweeping. Requires high load towing capacity and maneuverability, range, and endurance. 2500-shp turbine class.

6 Assault transport. Generally considered in medium and large sizes. Requires high speed and load-carrying ability. Range requirements vary and compromise load-carrying capability. A 2500-shp turbine class or multiples thereof.

7 Flying crane. Requires great load-lifting capability at the expense of fuel consumption and range. A rotor-tip drive for this requirement appears more efficient than a geared gas turbine.

Numerous specific problems must be solved during the engine development to meet Navy helicopter requirements properly. For example, engines must be fully qualified in endurance and performance using both JP-5 fuel as well as JP-4. Advance operations encountered by both the Army and Marine Corps create a requirement to operate on ordinary motor gas to ease the logistic support problem. Problems such as these are presenting obstacles to turboshaft-engine programs for helicopters; however, confidence is expressed that the turboshaft engine will contribute greatly to helicopter progress.

The Gas Turbine for Vertical Rising Aircraft.....57—A-226

By D. D. Weidhuner, Department of the Army, Washington, D. C. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Gas turbines are generally fulfilling their promise of being superior power plants for helicopters, although there are certain operational aspects which remain to be proved, such as sand and dust ingestion, all-fuel capability, and the desired long life.

Modification to the basic open-cycle gas turbine has been considered. The simple-cycle gas turbine is generally regarded as superior for the average helicopter mission. The use of a regenerator can reduce fuel consumption, but adds weight, bulk, and other complications.

Studies recently completed by the Army indicate that turbine use need not be confined to large sizes. Results of tests on an engine with 250-shp military rating showed that a very light engine can be built with satisfactory efficiency. Weights for a helicopter engine can be well under 100 lb.

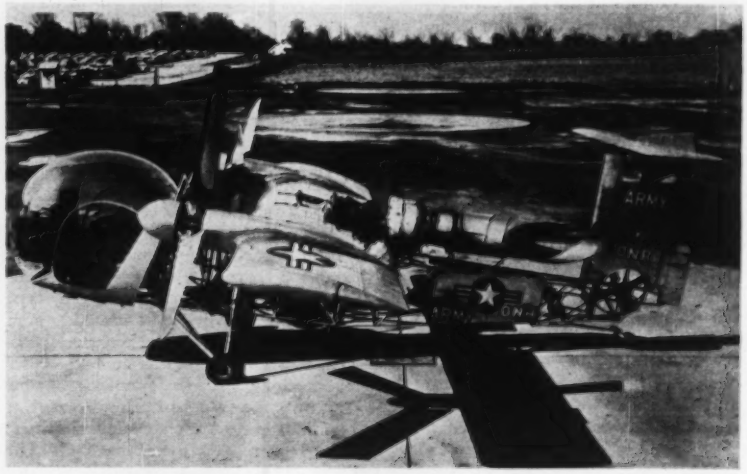
Several advantages result from this small, light turbine. The engine is one fourth the weight of a piston engine, and savings in airframe weight become significant. With the lighter engine, reduced fuel costs are made possible. Ease of handling small engines without special lifting cranes further reduces overall operating costs and can be of considerable advantage in military use.

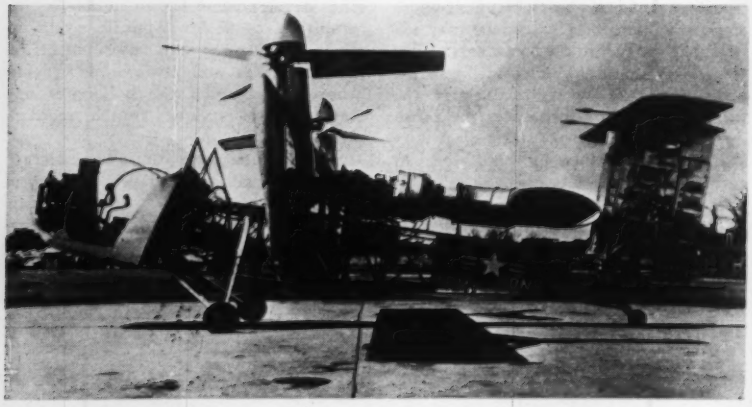
A small turbine for one-man lift devices is also being developed. The Navy is working on a 55-hp engine and the Army is developing a free-turbine version. The free turbine is considered to be essential for applications which have fixed-pitch rotors.

Rotor-tip-mounted turbojet applications of the turbine engine afford one major advantage in large helicopters. The extremely heavy and troublesome transmission is eliminated. Tip turbojets, however, require the development of a special engine at considerable expense.

Modification of an existing engine, if feasible, would reduce costs considerably.

Vertical take-off and landing aircraft, other than helicopters, are becoming popular. With this type aircraft, more power is required to lift a pound than in helicopters. The turbine with low weight and low fuel consumption finds an advantageous application in such craft.





Gas-turbine-engine application to vertical-lift aircraft capable of operating at all angles from beyond vertical to below horizontal. (57—A-226)

Fluid Meters

Problems in Measuring Steam Flow at 1250 Psia and 950 F With Nozzles and Orifices.....57—A-88

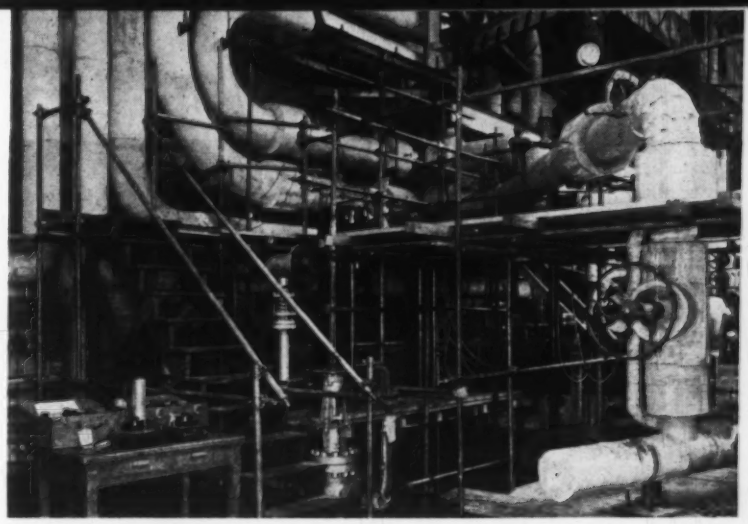
By J. W. Murdock, Mem. ASME, Naval Boiler and Turbine Laboratory, Philadelphia, Pa., and J. Goldsbury, Mem. ASME, General Electric Company, West Lynn, Mass. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

Measurement of steam flow at 1250 psia and 950 F with nozzles and orifices is discussed (*a*) during their calibration and (*b*) during performance tests on a turbine. All primary elements were constructed to ASME specifications, the nozzles being of long-radius, low-ratio design with throat taps, the orifices employing radius taps.

The calibrations for the flow nozzles indicated that reliable repeatable results could be obtained, although one nozzle exhibited an abrupt increase in discharge coefficient of about 0.5 per cent at about 2 per cent pressure differential. The measured coefficients of discharge were within Power Test Code "probable tolerances" of ±1.25 per cent. The calibrations of the orifices were of little value because of permanent distortion of the orifice plates as a result of difference in expansion between the plates and their holding flanges.

For measuring steam flows to the turbine, additional orifices were made up of different material, reducing distortion of the plates to the point of being negligible. The results of the turbine test with orifices and nozzles in series indicated excellent agreement between the flows based on orifice data using calculated coefficients and those determined from nozzle data using coefficients obtained from the calibration. Some trouble was experienced from deposits found around the nozzle throat taps.

While this paper presents data indicating excellent agreement of the two methods of flow measurement during the turbine-performance tests, it also points out the need for more experimentation and knowledge of steam-flow measurement at elevated temperatures and pressures.



Calibration setup for measurement of steam flow at 1250 psia and 950 F. Nozzle is located at the right-hand end of the lower leg of the outer U-shaped pipe. Downstream from the flow nozzle is a 90-deg elbow followed by a short length of straight pipe, then a 45-deg elbow, and then a 12½-ft length of straight pipe leading to the orifice. (57—A-88)

A Method for Predicting Supercompressibility Factors of Natural Gases.....57—A-69

By R. H. Zimmerman, Mem. ASME, and S. R. Beitler, Fellow ASME, Ohio State University; and R. G. Darrow, Assoc. Mem. ASME, Columbia Gas System Service Corporation, Columbus, Ohio. (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

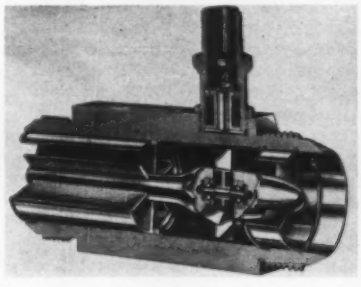
Accurate prediction of the supercompressibility factor for natural gases is of great importance to the natural-gas industry. This paper presents a working method for the accurate prediction of these factors within the pressure range of 0 to 3000 psi and in terms of gas properties generally known or conveniently determined. This method is the basis upon which the American Gas Association Supercompressibility Tables have been developed.

Dimensionless Correlation of Coefficients of Turbine-Type Flowmeters.....57—A-63

By H. M. Hochreiter, Mem. ASME, Fischer and Porter Company, Hatboro, Pa. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

Principles of dimensional reasoning are applied to a kinematic flowmeter of the turbine or propeller type. Experimental results are correlated over a wide range of fluid conditions and geometric variations, and coefficients are compared against those predicted from a one-dimensional design equation.

Axial-flow displacement-type flowmeter. 2-in. turbine meter. Courtesy Fischer and Porter Company. (57—A-63)

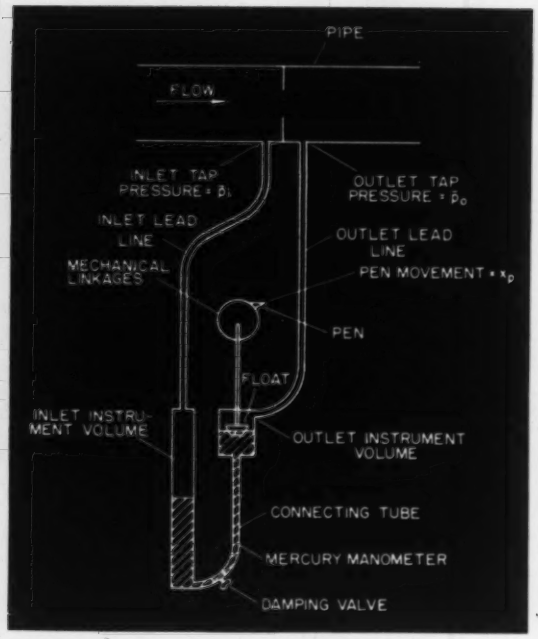


The kinematic flowmeter described here is of the turbine or propeller type manufactured by the author's company. It is an axial-flow displacement-type device in which the flow passes from a flow straightening section, past a rotor with helical blades, mounted in antifriction ball bearings lubricated by the flowing fluid. The rotor turns at a speed essentially proportional to the fluid velocity. Each blade passage induces a small alternating voltage in an external magnet and coil assembly, the signal being read out on an electronic pulse counter.

Analysis of the Effect of Pulsations on the Response of Mercurial-Type Differential-Pressure Recorders.....57—A-82

By R. J. Martin and D. S. Moseley, Southwest Research Institute, San Antonio, Tex. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

When pressure pulsations are present in a flowing gas stream whose flow rate is being measured by an orifice meter, the recording differential pen may be agitated severely if the frequency of the periodic pressure difference at the pressure taps is near the resonant frequency of some element of the meter system. When combined with the low resolution of the 24-hr, 7-day, or 31-day chart drive, results may often appear not as a line but as a ribbon of ink, called "paint." The term painting is familiar to most gas-measurement engineers. It is possible, however, to have pressure pulsations at higher frequencies than those of the meter system, and the recordings will appear as a smooth line and appreciable



Essentials of a mercurial-type differential-pressure recorder (57—A-82)

errors due to pulsation still may result.

Where paint occurs, one can only estimate the quantity of gas passing through the meter. Therefore, in meter design, it is desirable to prevent pipeline pulsations from affecting the pen motion, and heavy damping of the flow of the mercury in the meter is often provided by the presence of a valve restriction in the mercury flow channel.

This paper is restricted to an analysis of the behavior of the pneumatic and mechanical system which transforms a differential pressure at the inlet and outlet pressure taps to a pen motion suitable for recording. The paper represents an effort to study the frequency response of a mercurial-type differential-pressure recorder resembling those used in commercial practice.

It is thought that the analysis presented might be of assistance to the instrument designer. By using the equations and results of this analysis as a guide, he could select design parameters so that his instrument would have no natural resonances in the region of probable exciting frequencies.

Liquid-Flowmeter Calibration Techniques.....57—A-70

By M. R. Shafer and F. W. Ruegg, National Bureau of Standards, Washington, D. C. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

Calibration techniques for liquid flowmeters are discussed with emphasis on problems which are known to influence the accuracy of calibration procedures.

Also, reference methods which have been used to evaluate the comparative accuracy of different calibrators are described. The results of comparative accuracy tests on four calibrators of different designs are presented, and it is shown that the agreement between these is within ±0.15 per cent in the test range of 10,000 to 100,000 lb per hr. The many precautions necessary to approach this precision from the traditionally accepted "plus and minus one per cent" are given in detail.

Precise calibration of flow-rate meters requires a knowledge and control of each parameter which may influence the performance of the meter under test. Among these are the physical properties and temperature of the test liquid, at times the absolute pressure level, and the influence of upstream flow disturbances. The latter is perhaps the most difficult to specify and control when working to accuracies better than 1 per cent, and is one of the primary reasons for apparent discrepancies in results between different calibrators.

Extreme accuracy is now possible and certified standards are available for the measurement of mass, time, temperature, and density which a calibrator is required to control or indicate. However, in designing a specific calibrator, an intelligent selection of the instrumentation for range and sensitivity is necessary if adequate precision and accuracy are to result. Also, provisions must be included to insure that all of the liquid and only that liquid which passes through the meter will be collected in the calibrator.

Examples of both static and dynamic weighing calibrators have been presented. For the particular calibrators and flow ranges investigated, there is not a significant difference in the absolute accuracies. However, dynamic weighing methods are subject to errors which are not exposed by a static calibration of the instrumentation. Thus it seems desirable that dynamic weighing calibrators of new designs should be evaluated for accuracy by comparisons with other calibration methods.

Heat Transfer

The Variable Fluid-Property Problem in Free Convection.....57—A-46

By E. M. Sparrow, Assoc. Mem. ASME, and J. L. Gregg, Lewis Flight Propulsion Laboratory, National Advisory Committee for Aeronautics, Cleveland, Ohio. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

An analysis is made for the variable fluid-property problem for laminar free convection on an isothermal vertical flat plate. For a number of specific cases, solutions of the boundary-layer equations appropriate to the variable-property situation were carried out for gases and for liquid mercury. Utilizing these findings, a simple and accurate shorthand procedure is presented for calculating free-convection heat transfer under variable-property conditions. This calculation method is well established in the heat-transfer field. It involves the use of results which have been derived for constant-property fluids, and of a set of rules (called reference temperatures) for extending these constant-property results to variable-property situations. For gases, the constant-property heat-transfer results are generalized to the variable property situation by replacing β (expansion coefficient) by $1/T_\infty$ and evaluating the other properties at $T_r = T_w - 0.38\,(T_w - T_\infty)$, where T equals

absolute temperature, r is conditions at reference temperature, w is wall conditions, and ∞ is ambient conditions. For liquid mercury, the generalization may be accomplished by evaluating all the properties (including β) at this same T_r. It is worth while noting that, for these fluids, the film temperature (with $\beta = 1/T_\infty$ for gases) appears to serve as an adequate reference temperature for most applications. Results are also presented for boundary-layer thickness and velocity parameters.

Laminar Film Condensation of Pure Saturated Vapors on Inclined Circular Cylinders.....57—A-35

By Kamal-Eldin Hassan, Assoc. Mem. ASME, University of Cairo, Giza, Egypt; and Max Jakob, Mem. ASME, Illinois Institute of Technology, Chicago, Ill. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

Laminar film condensation of pure saturated vapors on inclined circular cylinders is treated analytically. The analysis is based on, and made under the same assumptions of, Nusselt's theory of film condensation. Experiments were performed to check the analytic results.

In the analysis, the problem is expressed in terms of dimensionless groups and the solution gives, in these terms, the local film thickness at any point on the surface of a cylinder. From the results of the analysis one can obtain the local film coefficient, and hence a mean film coefficient for the entire surface of any cylinder at any inclination.

The analysis shows that every tube has an optimum inclination at which the rate of condensation on the entire tube is a maximum.

The experiments were carried out by condensing steam on the inside surface of a thick copper tube $1^1/_4$ in. diam and about $8^1/_4$ in. long. The actual film coefficients obtained during the experiments were 28 to 100 per cent higher than those predicted by the theoretical analysis. The deviation from the theory increased with the inclination of the tube and the temperature difference between the tube surface and the steam.

Boiling Heat Transfer to Water Containing a Volatile Additive.....57—A-81

By G. Leppert, Assoc. Mem. ASME, and C. P. Costello, Stanford University, Stanford, Calif.; and B. M. Hoglund, Assoc. Mem. ASME, Argonne National Laboratory, Lemont, Ill. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

Utilization of the nucleate-boiling phenomenon in liquid coolants without net vapor generation is becoming more and more attractive in a number of high-performance heat-transfer applications. This mechanism, which is frequently called local boiling, permits the transfer of heat from a surface at a high rate with a relatively small temperature difference.

Typical applications for which local-boiling heat transfer may be advantageous include nuclear-reactor fuel elements, electronic-power-tube cooling coils, and rocket-engine cooling jackets. In most applications, it is desirable that vapor formation be as steady and smooth as possible, and in local boiling especially, smoothness is promoted by factors which tend to decrease the average size of bubbles leaving the heated surface.

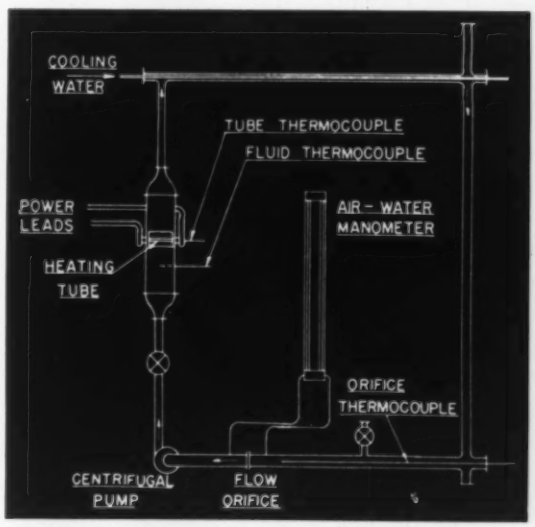
Consequently, it was considered to be of considerable practical importance, as well as of academic interest, when it was observed that very small amounts of certain organic fluids, when added to distilled water, decreased average bubble size and produced much smoother boiling than could be obtained with water alone. Furthermore, the generally desirable characteristics of water as a coolant were not sacrificed by the small additions.

The most apparent reason for desiring smooth and steady bubble formation exists in nuclear-reactor fuel channels where the coolant also serves as a neutron moderator. In this application, the reactor power level is strongly affected by the total mass of coolant in the fuel channels. If large aggregates of vapor are continually forming and collapsing, there will be a variation in the amount of moderator in the core and a tendency for the reactor power to oscillate.

In addition to the desirability of smooth vapor formation in any boiling nuclear reactor, there is a further advantage to small bubble size in a reactor in which only local boiling is permitted. It is characteristic of forced-convection local boiling that the bubbles grow on the heated surface to a maximum size, then collapse as they break away and encounter the main stream of fluid, which is at a temperature less than saturation. From the standpoint of average coolant density in a narrow channel, smaller bubble size will result in a relatively greater average volume occupied by liquid, and consequently in a greater average density.

The combination of more even boiling and smaller bubble size during forced-convection local boiling in a channel should also result in a lower static pressure drop and smaller pumping power. However, this situation has not yet been explored.

The present investigation consisted of the observation of the effect of up to 2.65-per-cent-by-weight isopropyl or methyl alcohol on the nucleate-boiling characteristics of distilled water. In addition to observing and photographing the character of bubble formation, careful measurements were made to determine the variation of the heat flux with the temperature difference from the surface to the liquid. The power level was increased in increments until the burn-out point was reached, at which point the nucleate boiling ended and film boiling commenced. With water, this phenomenon is generally accompanied by failure of the heater, since the surface temperature required to transmit the peak (or burn-out) heat flux in film



Schematic diagram of test loop for studies of boiling heat transfer to water containing a volatile additive (57—A-81)

boiling is above the melting point of the common metals.

Because there is need for additional experimental information for the forced-convection boiling of pure water flowing across tubes, nucleate boiling and burnout measurements are also reported without the additives which are of primary interest to this investigation. These measurements are needed here for comparison, and they are also useful as a confirming check on the correlation proposed by Rohsenow for nucleate boiling heat transfer.

Comparison of Total Emittances With Values Computed From Spectral Measurements.....57—A-29

By J. T. Bevans, Assoc. Mem. ASME, Shell Development Company, Emeryville, Calif.; J. T. Gier and R. V. Dunkle, University of California, Berkeley, Calif. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

The procedure, technique, and errors involved in using spectral reflectance data for computing total emittance at elevated temperatures are described. The effect of temperature upon the spectral data is discussed and, for the temperature range considered, this effect is found to be small. This is primarily a result of the predominance of the ever-present oxide film on metals. The error in extrapolating data for a surface subject to extreme changes above a certain temperature, is shown. A major source of error in the measurements derives from the preparation of a surface sample representative of the surface.

The technique of exposing a surface to various conditions of oxidation is one method of approaching the analysis of the transient radiation problem. This type of information is of great value in determining the changes which may be expected in the radiative heat load and to design for the worst conditions. An example in point is the behavior of the black-paint sample for oxidation at 700 F for 300 and 1000 hr. This sample also serves to illustrate the possible errors involved in the extrapolation of the emittance of a surface, particularly beyond the thermal treatment temperature.

Thermal Transfer in Turbulent Gas Streams—Effect of Turbulence on Macroscopic Transport From Spheres.....57—A-20

By Kazuhiko Sato and B. H. Sage, California Institute of Technology, Pasadena, Calif. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

The rate of thermal transport from spheres in a flowing stream is of interest in many industrial operations. Limited data are available concerning the effect of turbulence level on this transfer process. Measurements of the thermal transport from spheres to an air stream at four levels of turbulence were made at four velocities varying between 4 and 32 fps. Results are presented in terms of the Nusselt number. The experimental work is a portion of a detailed study of the local thermal and material transport from spheres in turbulent air streams. The data indicate a significant increase in the thermal transport with an increase in the level of turbulence at a constant Reynolds number. For example, the Nusselt number was increased from 53 to 62 upon an increase in the level of turbulence from 0.05 to 0.12 at a Reynolds number of 7200.

Transient Temperature and Thermal Stresses in Skin of Hypersonic Vehicle With Variable Boundary Conditions.....57—A-9

By Shih-Yuan Chen, Assoc. Mem. ASME, Republic Aviation Corporation, Farmingdale, L. I., N. Y. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

Structural design of hypersonic vehicles, such as aircraft and missiles, involves the problem of high thermal stresses resulting from aerodynamic heating. The computation of these thermal stresses depends directly on a knowledge of the existing temperature distribution.

Transient temperature distribution and thermal stresses resulting from aerodynamic heating in the skin of a vehicle at hypersonic speeds are found analytically for a finite slab in which one boundary has a variable coefficient of heat transfer and a variable adiabatic wall temperature while the other boundary is insulated. The purpose of this paper is to introduce the concept of using exponential functions of time to represent the coefficient of heat transfer and the adiabatic wall temperature. In general, one can choose as many exponential functions as necessary to obtain a better solution since the solution is a straightforward mathematical problem. This paper has considered the sum of two exponential functions and a constant for the coefficient of heat transfer, and the sum of two exponential functions and a constant for the adiabatic wall temperature. This represents several types of aerodynamic heating problems. Solutions for three special cases are given to show that the general solution also can be applied to simpler problems.

Applied Mechanics

A New Method to "Lock in" Elastic Effects for Experimental Stress Analysis.....57—A-71

By J. W. Dally, Assoc. Mem. ASME, A. J. Durelli, Assoc. Mem. ASME, and W. F. Riley, Armour Research Foundation of the Illinois Institute of Technology, Chicago, Ill. 1957 ASME Annual Meeting paper (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1958).

A new method is described for locking-in an optical interference pattern and a mechanical distortion. The transparent model is cast from a modified epoxy resin with an embedded rubber-thread grid. The model is permitted to cure before it is loaded. It is then held under load while the plastic continues to cure, and upon removal of the load an isochromatic fringe pattern remains which is proportional to the elastic distribution of the maximum shearing stress. In addition, the permanently distorted grid has deformations which are proportional to the elastic distribution of strains. The method is applied to a disk under diametrical compression and a disk under gravitational loading. A comparison of experimental and theoretical results for these two cases shows, in general, good agreement. Most of the discrepancies between experimental and theoretical results are due to the large deformations in the neighborhood of the points of load application. An application of the method to the solution of a three-dimensional problem, namely, the gravitational stress distribution in a buttress-type dam, is discussed briefly.

On Plane Stress Solution of an Elastic, Perfectly Plastic Wedge.....57—A-40

By P. M. Naghdi, Mem. ASME, University of Michigan, Ann Arbor, Mich. 1957 ASME Annual Meeting paper (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1958).

With the use of Tresca's yield function and its associated flow laws, the complete solution is obtained for an isotropic elastic, perfectly plastic wedge (with an included angle $\beta < \pi/2$) subjected to a uniform traction in the state of plane stress. Unlike its corresponding plane strain solution, the state of stress in a portion of the plastic domain of the wedge is at a corner of Tresca's yield hexagon where, in general, the normal to the yield surface is not defined uniquely.

The Pressure for Indenting Material Resting on a Rough Foundation... .....57—A-24

By W. Johnson, Manchester University, Manchester, England, and D. M. Woo, Sheffield University, Sheffield, England. 1957 ASME Annual Meeting paper (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1958).

When rigid, perfectly plastic material confined under conditions of plane strain and resting on a smooth foundation is indented by a smooth flat die, the plastic zones originating at the corner of the die fuse and spread through the material, the final plastic zone touching the foundation in one point only. While it is easy to calculate the necessary indentation pressure given this condition, it is considerably more laborious and somewhat more devious when the foundation is not smooth. It is assumed that a false head of metal attaches itself to the punch, but further, that a footing or zone of dead metal is developed in contact with the rough foundation.

To indent a material on a rough foundation under conditions of plane strain a slip-line-field solution is proposed and a general expression obtained for the necessary pressure. For extreme values of friction, calculated values are given.

Reflection of an Acoustic Step Wave From an Elastic Cylinder.... .....57—A-7

By Richard Skalak and M. B. Friedman, Columbia University, New York, N. Y. 1957 ASME Annual Meeting paper (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1958).

An elastic cylinder, circular in section and infinite in length, is considered in an infinite acoustic fluid. The object of this paper is the determination of the reflected and diffracted pressure fields at large distances resulting from a plane step wave of pressure impinging on the cylinder and moving in a direction normal to the axis of the cylinder. A formal solution is obtained for the general case of an elastic cylinder. Numerical results are computed for rigid, fixed cylinders, and for rigid, floating cylinders. Two different methods are used to achieve results in the different ranges of time which are of interest. A short time approximation is developed by the use of a double integral-transform method. A mode approach and a single integral transform are used for later times. The results show that the reflected pulse decays quickly, within a time on the order of the transit time of the original wave across the cylinder.

Comments on the Cutting of Metal Plates With High-Explosive Charges .....57—A-89

By W. E. Drummond, Stanford Research Institute, Menlo Park, Calif. 1957 ASME Annual Meeting paper (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1958).

The problem of the cutting of metal plates with high-explosive charges is analyzed by treating the metal hydrodynamically. The hydrodynamic problem is solved in the linearized approximation and it is assumed that the metal splits wherever the pressure becomes sufficiently negative. It is shown that such negative pressures occur where two rarefaction waves meet and the predicted location of these splits is in qualitative agreement with experiment.

Wood Industries

Steel Strapping of Lumber, Veneer, and Other Wood Products..... .....57—A-150

By E. P. Naumes, Acme Steel Company, Chicago, Ill. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Unprecedented demand for lumber and wood products over the past two decades, rapid advances in the development of mechanical-handling equipment, increasing costs of manual handling, and growing competition all have stimulated the streamlining of handling methods now employed in the transfer, storage, and shipment of wood products. The steel-strapping industry and others whose prime interests are in the materials-handling field have pooled their knowledge and skills to effect great savings in the wood-products industry.

Bundling and packaging and mechanized transfer—loading and unloading—have extended the efficiency of handling personnel, reduced costs, and simplified handling and storage at receiving yards.

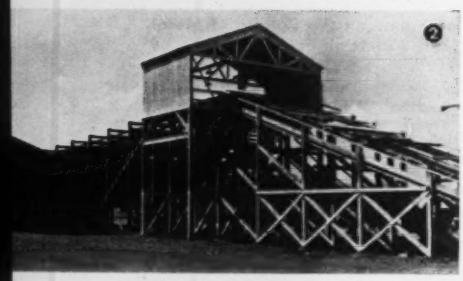
Equipment such as fork and straddle trucks enables one man, the operator, to transfer packaged items easily from storage or shipment or for breakdown and distribution. Packaged storage simplifies inventory and permits higher stacking in storage areas.

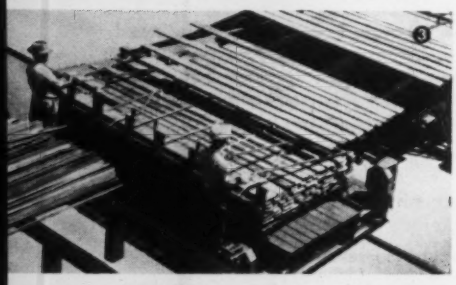
The steel-strapping industry supplied ideas, tools, and materials for packaging and mechanized-handling development.

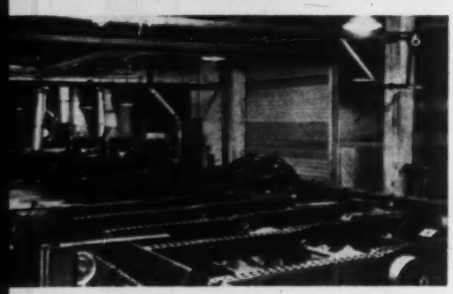
Strapping equipment includes separate tensioning, sealing and cutting functions in one piece of equipment; pneumatic, hydraulic, and electric tensioning tools; pneumatic sealers; semiautomatic and automatic-strapping machines which substitute for human efforts and provide measured tension to the strapping.

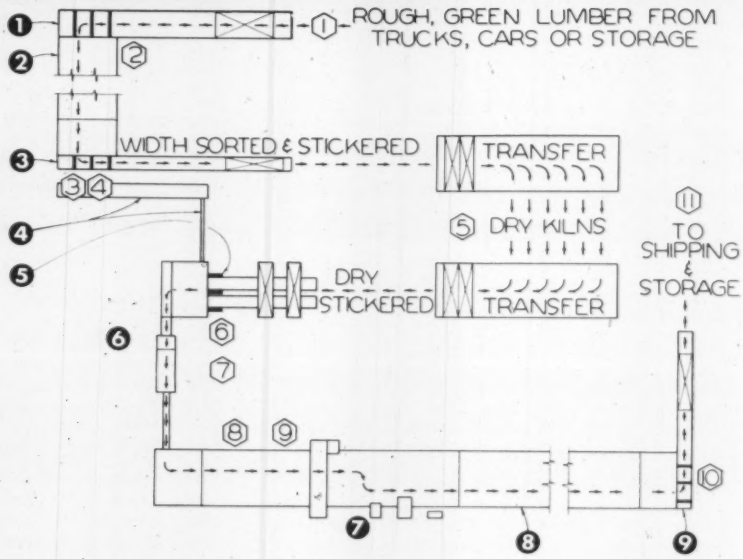
Along with his comprehensive treatment of steel strapping, tools, and equipment, the author covers log bundling; packaging and shipment of rough dimension and industrial lumber; loading and unloading techniques used with wood products such as veneer, flooring, plywood, and wood skids.

Unit of quality paneling bound with steel strapping is stacked by fork-lift operator. Sections, such as these shown, can be adapted to conveyerized packaging lines and automatic strapping machines. (57—A-150)





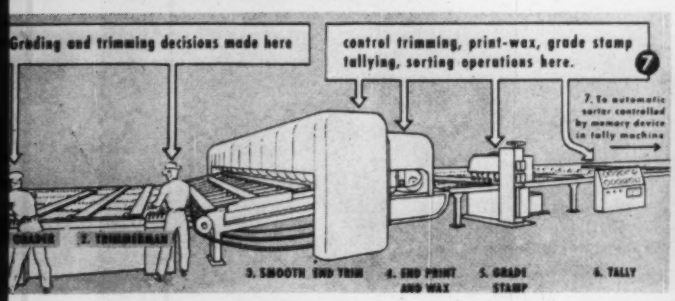


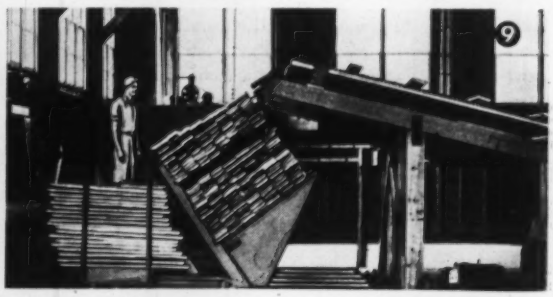


The Automatic Lumber Planing Mill .....57—A-16

By Peter Koch, Michigan State University, East Lansing, Mich. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Automatic lumber planing mill. Flow plan, *above*, of pine lumber remanufacturing plant is arranged so that 11 men (stationed at points designated by numbers in hexagons) plane, double-end trim, end-print, grade stamp, tally, sort, and put into dry storage 60 to 100 thousand board feet of lumber per eight-hour day. Rough, green lumber is off-loaded from incoming trucks or transferred from green storage onto a roll case feeding a large tilting loader, **1**, which is equipped to handle an entire truckload of green lumber. A single operator breaks the load down onto a short lugged conveyer chain which in turn feeds a multideck sorter, **2**. Conveyer is so arranged that each board is loaded behind a set of lugs, and as boards descend past the horizontal apertures at the beginning of each storage level, they are measured automatically for width and shunted off onto the proper level. As one level or tray is loaded with lumber, the stop can be lowered and the boards delivered onto a hinged, powered conveyer that delivers the accumulation of lumber to a semiautomatic stacker, **3**. The package then moves clear of the stacker by means of a powered roll case and is removed by a fork lift and built into full kiln charge. Following discharge from the kiln, the charge is broken down into its component packages by means of a fork lift, and these packages are then transported to the apron-deck conveyer, **5**, leading to the presurfacer, planer, and matcher. At this point, a single operator simultaneously breaks down the lumber package onto the planer feed table and returns the kiln sticks to a conveyer, **4**, convenient to the stacker shown in **3**. The feed table, **6**, delivers boards in a steady flow to the planer and matcher. Planed lumber is exhausted upon a short section of conveyer chain which terminates in a device that automatically loads each board in front of a set of lugs on a set of moving chains. A grader studies each board as it passes before him and by activating a switch controlling a memory device he feeds a suitable impulse into the grade marker, **7**, the tally machine, and the multideck sorter, **8**, similar to that in **2**. Simultaneously, he instructs the trimmer man to remove defects in order to upgrade the boards. On emerging from the trimmer, the ends of each board are automatically stamped with a suitable grade mark and waxed. From the printers and waxers, the lugged conveyer carries the boards in front of the tallying device which measures the board length and combines this information with that previously received from the grader. The lumber is again sorted and stacked on an automatic stacker, **9**, and removed on a roll case for subsequent pickup and transport to dry storage.


Grading and trimming decisions made here
control trimming, print-wax, grade stamp tallying, sorting operations here.
7. To automatic sorter controlled by memory device in tally machine
GRADER
2. TRIMMERMAN
3. SMOOTH END TRIM
4. END PRINT AND WAX
5. GRADE STAMP
6. TALLY



Management

Human Factors in Engineering Design.....57—A-56

By Renato Contini, New York University, New York, N. Y. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

The engineer is primarily responsible for the application of existing technology to the development of tools and equipment for which man is the operator, or of the systems and environments in which he operates. This development is necessary to maintain or increase man's output to improve the efficiency of his operations, to promote his safety, to preserve his well-being, and even to extend his control over his environment.

In every design of modern equipment where man plays a role, active or passive, those disciplines which are most sophisticated should be involved. Almost every aspect of design or manned aircraft presents some problem which calls for the knowledge of a physiologist or psychologist or anthropologist or medical scientist.

The proper design of the seat is affected not only by the surrounding structure but by the man who is seated in it. What accelerations can he tolerate and how can he take these? The flight control system, even if normally under automatic operation may, at some instance, be under the control of the human operator, and his physical strength and sensory capacities will influence the design. The instrument panel is made necessary because of him and is confined in its extent and composition to his capacities to absorb the information displayed. The cabin must be pressurized because of him, or he must be provided with other defenses against an extreme environment. Together with sensitive equipment he must be protected against sudden or prolonged applications of unusual stress.

The design of the modern airplane, if it is to be manned or carry human cargo, has become a team effort and the engineer is only one member of that team. That the team approach to design produces satisfactory results is illustrated by a number of research projects, either completed or in progress, at the New York University Research Division, College of Engineering. The team approach to such diverse designs as an air-evacuation litter, prosthetic devices, radar equipment, and flight suits, is presented in this paper.

Control of Engineering Work in a Product Development Laboratory .....57—F-36

By R. W. Barber, St. Regis Paper Company, Trenton, N. J. 1957 ASME Fall Meeting paper (multilithographed; available to July 1, 1958).

A system which is used to control the activities of a medium-sized product development laboratory is described in this paper. The description high lights:

1 A procedure for evaluating and authorizing the intake of project assignments.

2 A method of controlling the priority of work assignments.

3 A simplified system of recording and filing pertinent information on development projects.

4 A method of recording and computing project costs.

5 A procedure for review and termination of projects.

There are several important forms that are essential to the success of the system: Development request form, project priority card, project status card, classified technical project file.

Notes, follow-ups, correspondence, requisitions, shop orders, and such, are of secondary importance and it is considered advisable to destroy them as soon as their purpose has been served.

The system, in practice, is quite simple and has proved easy to use. While there is considerable rigidity of procedure to adhere to, it has been proved to the author's satisfaction that it is sufficiently flexible to meet the ever-changing circumstances. It has proved effective in the streamlining of activities and in increasing efficiency. It is felt that the adaptation or modification of procedure given in this paper may prove helpful to other organizations having similar problems.

Metal Processing

The Effect of Tool-Chip Contact Area in Metal Machining.....57—A-45

By H. Takeyama and E. Usui, Government Mechanical Laboratory, Tokyo, Japan. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958.)

Conventional machining equations do not indicate which factor is the cause and which is the result in the process of metal machining, because the equations were derived mostly by the least-energy principle. Furthermore, the so-called coefficient of friction in metal machining involves many paradoxes or contradictions, although it has been regarded as an index of machining characteristics.

The purposes of this paper are as follows: To clarify the meaning of the so-called coefficient of friction in metal machining; to analyze the stress distributions on the rake face; to investigate the significance of tool-chip contact area in metal machining.

Through various tests, the tool-chip contact area has been proved to be a controlling factor in metal machining. By using this new factor, the correlations between various machining characteristics as well as the meaning of the coefficient of friction can be clarified.

This paper stresses the effect of the tool-chip contact area in metal machining. Little attention has been paid to this variable in analyzing machinability. According to authors' tests, the tool-chip contact area is closely related not only with the machining performance but with the tool life. This paper treats the former subject, summing up the results obtained by the experiments using special devices.

The Spiral Point Drill—A New Concept in Drill Point Geometry.....57—A-98

By Hans Ernst, Fellow ASME, and W. A. Haggerty, The Cincinnati Milling Machine Company, Cincinnati, Ohio. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

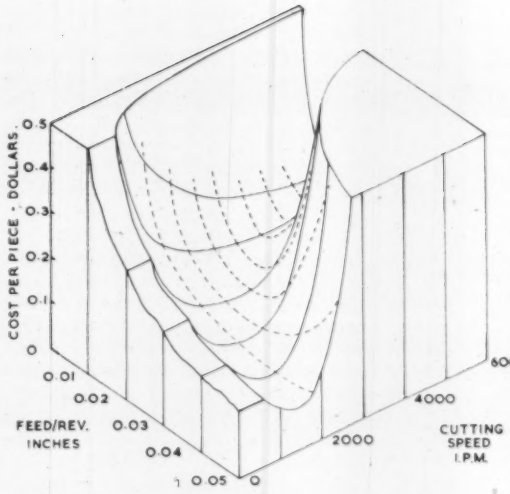
The drilling process is one of the oldest and most widely used manufacturing operations. Billions of holes are drilled each year, and over 100 million drills are manufactured annually in the United States alone. However, in spite of its economic importance, the geometrical shape of the drill point (the so-called "chisel edge") has remained virtually unchanged for over a hundred years, even though its disadvantages of lack of centering and poor cutting action at the center have long been recognized.

This paper describes an investigation into the cause of these disadvantages and a search for other geometrical forms which might result in improved performance. In the course of this investigation a "three-dimensional spiral" point shape was devised with interesting technical and performance characteristics, together with a unique method of point generation.

Photomicrographs are presented showing sections through the drill point and partly formed chips at various points

along the cutting edge, both for the conventional chisel point and the spiral point shapes, showing characteristic differences in chip formation. The results of a series of investigations of cutting forces and other performance criteria such as roundness, hole size, and drill life, are presented for both of these shapes, together with a few case histories of results obtained with the new geometry under repetitive manufacturing conditions. A description is given of a method for producing this shape on any type of drill.

A modified form of the basic spiral point geometry is shown, which has additional unique characteristics for the drilling of sheet metal, and which therefore may have important applications in the aircraft and other sheet-metal fabricating industries.



Three-dimensional plot of relationship between cost per piece, feed, and cutting speed. Full lines are curves at constant feed rate and broken lines are curves at constant speed. (57—A-58)

On the Economics of the Basic Turning Operation.....57—A-58

By R. C. Brewer, The Royal Technical College, Salford, England. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

The general economic problem of turning is fairly well appreciated from a qualitative viewpoint; namely, that the reduction in machining cost as the cutting speed is increased will be eventually more than offset by increased tool changing and grinding costs. The problem involves, however, a great number of variables and it must be conceded as axiomatic that the number of variables which can be conveniently handled mathematically is such that a great deal of generality is lost. There is a further risk of loss of generality in attempting to represent the mathematical results in a form suitable for application, preferably graphical. This paper attempts to achieve the initial goal of including at least the fundamental variables in the analysis and representing the results in a reasonably useful form.

Hydraulics

Flow Characteristics of a Multiple-Cell Pump Basin.....57—A-59

By W. L. Dornaus, Mem. ASME, Byron Jackson Division, Borg-Warner Corporation, Los Angeles, Calif. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

Scale model, one-to-ten, of a large pumping plant gives quick and relatively inexpensive answers to questions concerning proper pump submergence, spacing, influence of baffling, and mechanical appurtenances such as screens and gates. Inlet "river" along front of tank not to scale. (57—A-59)

Considering the continually increasing demands today for more and more water, it is rather surprising to find that relatively few data are available for proper pump-basin design. The principal reason is probably the diversity of situations encountered and the fact that generalizations are difficult to make from specific case studies. Most investigators agree with Fraser that a "wet pit pump is no better than its intake performance and as much study and investigation must go into its design as into the pump itself."

The problem of pump-basin design is of paramount importance to the manufacturer of pumps since the majority of problems encountered in present-day pumping occur at the suction end of the pump. This is not to say that pump design at present is weak on the suction components, but rather that many troubles blamed on the pump occur primarily because of improper suction-basin design.

Variations of the flow pattern in a pump-suction pit containing a variable number of pumps in operation are of interest in studies to determine the most economical pumping structure. The use of a one-to-ten scale model of a large pumping plant gives quick and relatively inexpensive answers to questions concerning proper pump submergence, spacing, influence of baffling, and mechanical appurtenances such as screens and gates, and the relative influence between two or more pumps with various numbers of units operating together. Visual effects for flow observation make positive analysis fairly simple. Use of Froude's law in this investigation confirms results of previous experimenters and simplifies test procedure.

On the Art of Designing Compressor Foundations.....57—A-67

By W. F. Swiger, Stone and Webster Engineering Company, Boston, Mass. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

Over the years a number of rough rules of thumb have been developed and used for designing compressor foundations. It is perhaps time that the theories of soil mechanics which establish the behavior and distortions of soil under static and vibrational loads, and studies on deterioration and distortion of concrete be summarized in the hope that a more rational basis for the design of compressor foundations may be evolved.

Foundations for compressors must perform several functions. Among these:

Support the machine without distortion which could cause damage by cracking or misalignment; limit settlements to acceptable amounts in order to prevent damage to piping or structures; limit vibration to acceptable amounts.

The designer of foundations for vibrating machines, such as compressors, must consider several related fields. The behavior of soil under static and vibrational loads and the magnitude and effects of soil distortions must be evaluated. Means of limiting vibration and the possibilities of deterioration or distortion of the actual foundation must be considered. This paper summarizes the relationship of present thinking and recent studies in the various fields to compressor foundations.

One-Way Surge Tanks for Pumping Plants.....57—A-25

By John Parmakian, Mem. ASME, U. S. Department of the Interior, Denver, Colo. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

The graphical method of water-hammer analysis for pump-discharge lines has been well established. In order to determine the transient hydraulic conditions at the pump and discharge line subsequent to a power failure at the pump motor, three effects must be considered; namely, the pump and motor inertia, the pump characteristics, and the water-hammer wave phenomena in the discharge line.

One-way low-level surge tanks may be used for the control of water hammer at pumping plants where water-column separation occurs in the discharge line subsequent to a power failure at the pump motors. This paper describes the characteristics of these tanks and also includes a typical graphical water-hammer solution of the problem.

ASME TRANSACTIONS

THE January, 1958, issue of the *Transactions of the ASME* (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

Technical Papers

The Determination of the Equation of State From Wave-Front Observations, by E. F. Lype. (56—A-129)

The Viscosity of Five Gases: A Re-Evaluation, by J. Kestin and H. E. Wang. (56—A-72)

Convection Heat Transfer and Pressure Drop of Air Flowing Across In-Line Tube Banks, I, by C. E. Jones and E. S. Monroe, Jr. (56—A-126)

Convection Heat Transfer and Pressure Drop of Air Flowing Across In-Line Tube Banks, II, by A. J. Gram, C. O. Mackey, and E. S. Monroe, Jr. (56—A-127)

Shell-Side Characteristics of Shell-and-Tube Heat Exchangers, by T. Tinker. (56—A-123)

Heat Transfer and Fluid Friction During Flow Across Banks of Tubes, VI, by O. P. Bergelin, K. J. Bell, and M. D. Leighton. (56—A-133)

Sublimation From Disks to Air Streams Flowing Normal to Their Surfaces, by H. H. Sogin. (56—A-115)

Heat Transfer From a Rotating Cylinder With and Without Crossflow, by W. M. Kays and I. S. Bjorklund. (56—A-71)

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COMMENTS ON PAPERS

Mechanical-Assembly Equipment

Comment by William Bayley[1]

UNTIL a few years ago, the introduction of transfer-type assembly machines seemed to have plodded along behind the use of transfer machining machines. It can be seen from this paper[2] that great progress is being made in this field and the author and his staff apparently have a sound and practical approach in analyzing the economic considerations essential to proper introduction of new assembly equipment. We at AC Spark Plug know this to be true through working with his Section on many machines for our plant, including a few of those touched upon in the paper just presented.

It is true that a proper analysis of the production requirements, possible future part changes, complexity of operations and above all the calculated savings from various possible new methods of assembly of the product often result in a justification of only a slight improvement in one's present equipment and not an expensive automatic machine. Many times we have found that a two-station machine with the operator alternating from one station to the other, can produce as many pieces per hour as a more expensive rotary. It is particularly well to lean toward this type of equipment if a product may easily be obsolete or radically redesigned in a short time, unless of course, the equipment can be designed to be easily converted to a major product change or another product.

Realizing that quality control of parts usually becomes more important if they are to be automatically loaded, there also are certain advantages in automatic assembly. Better quality assemblies are produced and fewer incorrect assemblies leave the plant because of the usual practice of having automatic 100 per cent checking or gaging stations on most assembly machines. This always contributes to keeping warranty costs to a minimum.

The cost of controlling quality in the parts to be automatically fed must always be considered. In manually assembling odometer wheels in our plant, out-of-round and off-dimension wheels, within reason, meant little; but an experimental feeding mechanism for automatic assembly showed the opposite to be true. The cost of reworking all of the molding dies for these parts amounted to approximately $15,000.

There are other specific gains often acquired with automatic equipment worth some consideration even though they may not show up in an economic evaluation. These can include elimination of stock banking, removal of the human element, such as errors, from the process, greater safety, less floor area used, and less operator fatigue. It often is desirable to transfer drudgery to automatic machinery and use as brains and brawn the electrical and hydraulic systems which can be contrived.

Because it often is necessary to have an operator in attendance on small, fully automatic assembly machines, it often pays to have this operator load some particular part which may be troublesome in automatic feeding. Thin gaskets and coil springs fall in this category and with the operator loading some part such as this, she still can watch over the machine if it is not too large.

True, the emphasis cannot be focused only on the savings in direct labor. Additional skilled help to maintain and service the more complex electrical and hydraulic systems of the automatic equipment means something in the study to be made of new methods. However, in these fields, planned specifications incorporating quality and simplicity, are a must to keep the skilled labor requirements to a minimum.

With many of the problems encountered in machining machines such as chip disposal, coolant systems, cutter problems, and so on, not present in assembly machines, the mechanical features usually can be obtained satisfactorily in a short time once the decision is made on the most economical method of doing the operations.

In conclusion—enthusiasm for a new approach should include a thorough study of the economics involved in proper planning for new assembly equipment.

Comment by L. C. Lander[3]

IN THIS paper[2] the author emphasizes the importance of a complete and careful analysis of the economic factors before proceeding with automatic assembly equipment. He clearly states a direct method of analyzing the spectrum of the many economic possibilities that confront the buyer or user of mechanized assembly equipment.

Engineering economics is a field of study in itself and at this point the importance of a complete and careful analysis of the economics of all factors should be amplified. I have taught this subject for 15 years at General Motors Institute, and have been the supervisor of approximately 100 project studies regarding the improvement of operations and processes that were investigated by graduates of the four-year co-operative engineering program, during their fifth-year projects. One objective of the fifth-year project is to give the graduate of our co-operative four-year program an opportunity to become a working member of the organization by assigning him an engineering problem to solve. Many of these problems pertain to automation of a process or operation and serve to emphasize accurately the statement by the author that "the mechanical problems of automation, although sometimes difficult, are secondary to the engineering economics of the situation." The economics of the situation usually calls for a study of many alternatives.

[1] Supervisor, machine design and hydraulics, AC Spark Plug Division, General Motors Corporation, Flint, Mich.

[2] "Mechanical-Assembly Equipment," by G. R. Fitzgerald, MECHANICAL ENGINEERING, vol. 79, April, 1957, pp. 332–334.

[3] Chairman, Industrial Engineering Department, General Motors Institute, Flint, Mich. Mem. ASME.

The many alternate solutions of any improvement possibility situation are based on actual on-the-floor costs of all items that go into a particular situation that is to be improved. The determination of present cost usually entails a special on-the-floor control system since accounting department records in themselves are not specific enough and in enough detail to get the true cost picture. The pattern usually followed is:

1 Determine present on-the-floor cost of fabricating the part.

2 Get machine costs to perform the fabrication automatically. This step usually involves several alternate machines and methods of fabrication. Each method may be questioned as to its reliability concerning its needs for operators or attendants. When machine attendants are considered, the cost of fabrication changes and at the same time the machine design changes so as to allow the machine attendant to perform those steps in the fabrication that require costly and unreliable mechanisms; this adds more alternate solutions and naturally leads to applying the old principle of using the equipment and tools that are on hand more effectively.

3 To use what we now have more effectively requires a detailed study of the present fabricating method taking into consideration all suggestions for improvement and detailed improvement possibilities regarding the fabrication line-up. Improvement ideas are frequently "filed" especially when the attitude in the plant is that there is no need to improve a line-up if it is planned eventually to do the job automatically. The installation of simple lower-cost improvements gives another alternate method which when used as a cost basis of comparison for the previously considered automatic and semiautomatic methods may cause the previously considered method to be uneconomical at the operating level.

These operating level economics, of necessity, must be evaluated in light of over-all returns to an enterprise taking into consideration the taxation structure in particular to get the true engineering economics of the situation. What was previously uneconomical becomes economical and vice versa. These gradual changes have been very well named as Technological Improvements as they involve improvements in all engineering fields concerning the many items that go into our products, fabrication line-ups, and the plant settings of these fabrication line-ups.

As a summary, I suggest that the steps should be to get all the economic and operating facts, analyze them, and then the course of action will be more apparent. Sometimes it may mean automation, but at other times it might mean that improving and making more effective use of what is already in operation is the best answer.

Free-Piston Gasifiers

Comment by Arthur F. Underwood[4]

THE interesting feature of this paper[5] is the wide application of these power plants. It is not generally appreciated that, at the present time, there are almost a hundred in commercial service and that, by the end of 1957, the number will be above 180 units. This record demonstrates the SIGMA engine to be well past the experimental stage and to be an accepted power plant.

Our tests with these and similar free-piston engines show that the high efficiency and relative insensitivity to fuel quality are correct. In fact, it will be interesting to investigate further the use of stabilized crude oil and shale oil as possible low-cost fuels.

The authors describe the combined cycle using the gasifier with a steam cycle and show the efficiency of the combined cycle to be equal to the efficiency of the gasifier-turbine cycle. Then one might ask the question, why it would be desirable to utilize the combined cycle. Unless the total capital investment is less, there would seem to be no advantage.

In the list of advantages reported by ship engineers, the authors have not included (although we are certain they are cognizant of it), the point that was made to me by the chief engineer of one of the French coastal vessels. He explained he could inspect the principal parts of one engine while the cargo was being unloaded and reloaded. Even the replacement of a center section can be carried out in about 50 hours, with four men. However, this was not possible with the diesels he had operated. Inspection of the moving parts could not be made during the time in port. A major failure of a large diesel would possibly mean many weeks or even months out of service.

Author's Closure

MR. UNDERWOOD comments upon fuel insensibility and easy maintenance of the gasifiers. We entirely agree with him.

We wish to make some comments upon the combined gasifier-steam cycle.

First, the example given in the paper has no exceptionally high plant efficiency, but it was the only one available worked out in detail by gas turbine-steam plant-gasifier manufacturers. It shows a 16 per cent reduction of specific fuel consumption and a 40 per cent reduction of implantation area as compared to a steam cycle, by very conservative pressures and temperatures for gas and steam cycles.

Second, compared to other steam cycles of higher efficiency and output, an efficiency increase of at least 10 per cent is possible by applying the mixed cycle at the same steam conditions.

The comments of Mr. Underwood are mainly dealing with the comparison of the mixed cycle and the pure gasifier cycle, which has in itself an excellent efficiency of approximately 35 per cent at terminals.

Up to 15,000–20,000 kw, there is in fact no special incentive to prefer a mixed cycle, unless an important combined steam and power production is needed. The pure gasifier power plant is probably the best and most homogeneous solution.

A 25,000-kw plant would, however, require at least 30 gasifiers of the present production type GS-34. In order to reduce maintenance, a reduction of the number of units may be achieved by supercharging, intercooling, and afterburning or by applying a mixed gasifier-steam cycle.

In the mixed cycle, only one quarter of the total power is produced by the gas turbine and the number of gasifiers installed is reduced proportionally. Gasifier maintenance and lube oil consumption are therefore one fourth of corresponding values of a pure gasifier cycle. This reduction also applies to many auxiliaries, such as gasifier fuel system, oil and water coolers, and so on.

In addition, the part-load behavior of the mixed cycle is exceptionally good. At quarter total load, the power is mainly produced by the gas turbine working at its own full load, and so the over-all plant efficiency is fairly well maintained down to very small total load.

Finally, at still higher power installed, steam conditions become more favorable and so the mixed cycle efficiency may reach values considerably higher than the individual efficiencies of pure gasifier or pure steam plants, while the number of gasifiers installed remains quite reasonable.

In conclusion, this brief and incomplete comment shows that the choice between a pure gasifier cycle, a mixed cycle, or a

[4] Research Staff, General Motors Corporation, Detroit, Mich. Mem. ASME.

[5] "French Experience With Free-Piston Engines," by M. E. Barthalon and H. Horgen, MECHANICAL ENGINEERING, May, 1957, vol. 79, pp. 428–431.

conventional steam cycle depends on working conditions as well as capital investment. The mixed cycle has probably a fair chance for power plants between 25,000 and 100,000 kw, when gasifier reliability becomes more generally accepted and when the advantage of individual gasifier maintenance at full plant load is more generally realized.

H. Horgen.[6]

Woodworking Accuracy

Comment by Rudolph Willard[7]

In this paper[8] the author mentions field tests indicating savings of about seven or eight per cent. Many of us evaluate new methods in terms of total-dollar investment compared to total-dollar savings in a year. I wonder if the author can give us approximate figures for cost of the gages and also for annual savings as indicated by his field tests.

There is no doubt that humidity control will reduce the shrink, swell, warp, and checking in wood. Many factories probably feel that their losses and troubles from these sources would not justify investment in humidity-control equipment. It is encouraging to see that the author's experience convinces him that it is worth while.

I would like to sound a note of caution, however. Furniture will not always stay in the factory. It will go into homes in diverse climates and with no humidity control. Sealers, lacquers, and varnish do not prevent transmission of atmospheric moisture into the wood, but merely slow it down. Even with controlled humidity in the factory there will be trouble in retail stores and warehouses, and in homes, unless the construction of the furniture provides against trouble from shrink, swell, checking, and warpage. It is necessary to provide adequate clearance, use floating attachment of parts where needed, tie down, or otherwise provide for offsetting warpage.

Given proper construction of the furniture, humidity control in the factory is excellent. But, if I had to choose one or the other, I would choose proper construction first. As an industry, we furniture manufacturers do not pay enough attention to construction which will reduce trouble at final destination, in Mrs. America's home.

Solar-Heated Buildings

Comment by R. W. Bliss[9]

Solar-heated buildings, especially those in which the occupants are actually and regularly kept comfortably warm, are not too common in the United States. If we arbitrarily define a solar-heated building as one which derives at least half of its total winter space-heating energy requirement from incident sunshine then there were only two or three such solar-heated buildings of any type in actual successful operation in the United States during the past winter. One of these was the Bridgers & Paxton solar building described in the paper[10] under discussion. It is the largest solar-heated building presently in operation, and in some respects is based on the most advanced design so far developed.

This building is a tribute to the ability, vision, and enthusiasm of this moderate-sized New Mexico engineering firm. Using their own funds entirely, they have designed, built, and are now testing this experimental heating system. This solar heating system is designed around the sound concept of collecting solar energy at whatever temperature level it can be conveniently collected under the particular day's weather conditions, and then using a heat pump when necessary (and only when necessary) to "pump" the collected solar energy up to the temperature level needed for the space-heating system. The heat pump is required to move only a portion of the seasonal heating load, and it moves that portion at a rather high coefficient of performance. Hence the winter seasonal operating cost of the system should be quite low. In common with the few solar-heated buildings which have preceded it, and with many which will follow it, the Bridgers & Paxton building is not, of course, the last word in economically practicable solar heating. But it is a significant pioneering step in this potentially important field.

The practical operating difficulties described by the authors are typical of the "bugs" which seem to have a special and exasperating affinity for large solar heat collectors. From some experience in this matter, our own personal view is that large collectors are inherently and inexplicably endowed with more "general cussedness" than is really befitting to such apparently simple devices. The removal of these bugs associated with solar heat collection systems is a definite and important part of the problem of developing commercially sound systems.

The performance data presented in this preliminary paper are of necessity sketchy, and it is to be hoped that sufficient instrumentation can be obtained to permit a more detailed performance analysis. Two of the many measurements which at present appear strongly needed are those of incident sunshine upon the collector plane, and those of the power consumption of the heating system. We look forward to a more detailed performance analysis of this fine solar building, whose designers are to be congratulated for the excellent steps they have taken toward a better solution of the increasingly important problem of providing better space-heating with less fuel consumption.

Authors' Closure

The authors appreciate Mr. Bliss's kind comments. We should also like to acknowledge the help and encouragement given us by Mr. Bliss while this project was still in the design stage.

More performance data have been obtained and analyzed and the complete results of the first winter's operation of the system will be presented in a paper at the annual meeting of the American Society of Heating and Air Conditioning Engineers at Pittsburgh, Pa., in January, 1958. This paper will show operating costs and sources of energy consumed, in addition to other data.

R. W. Haines.[11]

Quality Control

Comment by W. C. Siff[12]

I should like to offer two comments on this paper.[13]

The term "statistical quality control," as it is used here, and the rather deprecat-

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[7] Professor, North Carolina State College, Furniture Manufacturing and Management, Raleigh, N. C.

[8] "Woodworking Accuracy," by Henry B. Pittman, Jr., Mechanical Engineering, vol. 79, June, 1957, pp. 542–545, condensed from ASME Paper No. 57—WDI-3.

[9] Institute of Atmospheric Physics, University of Arizona, Tucson, Ariz.

[10] "Solar Heat for a Building," by F. H. Bridgers, D. D. Paxton, and R. W. Haines, Mechanical Engineering, vol. 79, June, 1957, pp. 536–538.

[11] Chief engineer, Bridgers and Paxtone Albuquerque, N. Mex.

[12] Senior quality engineer, The General Tir, & Rubber Company, Akron, Ohio. Assoc. Mem. ASME.

[13] "Statistical Control for Small Plants," by Allan Fredhold, Jr., Mechanical Engineering, vol. 79, July, 1957, pp. 652–655, based on a paper contributed by the ASME Management Division and presented at the SAM-ASME Management Conference, New York, N. Y., April 25–26, 1957.

ing reference to inspection as a "screening station separating the good from the bad and disposing of the defectives at considerable expense" implies that statistical quality control is all there is to quality control. This is like saying that arithmetic is all there is to accounting or that calculus is all there is to aerodynamics, when in each case, the mathematical technique is nothing more than a tool. Statistics is an important tool in quality control—one of the most valuable available to the quality-control engineer—but it must, in all fairness, take its place beside others—all necessary to correct effectively poor quality and prevent defects so as to enable production at the most economical levels consistent with customer satisfaction.

Statistics is only a body of mathematical technique for the efficient processing of data. Its results can be no better than the data on which it operates. Without an aggressive program of periodic gage verification to ensure reliable measurements, statistical results may be open to serious question. Without well-trained inspectors to gather reliable data, statistical analyses may lead to incorrect conclusions. Without adequate specifications to define good product and bad, and to relate both to the customer's requirements, the results of the statistical analysis may be of little practical value. Without a knowledge of the amount of loss due to poor quality and the cost of reducing it, the statistical analysis may not be economical.

While these few sentences fall far short of describing a complete quality-control program, they perhaps serve to illustrate that quality control is considerably more than statistical quality control, and that the successful use of statistical methods in quality control is in large measure dependent on how good a foundation has been established by the other aspects of the total quality-control activity.

The author defines an acceptable quality level for a sampling plan as the percentage of defectives that probably will be passed in the long run. The AQL is more properly defined as that percentage of defectives which will be considered satisfactory as a process average. It is a convenient way of indexing sampling plans since lots of AQL quality will have a high probability of acceptance.

In the example given by the author, lots of 500 pieces which contain 1 per cent defectives will be accepted nine times out of ten and the percentage of defectives that probably will be passed in the long run is indeed 1 per cent. (The slight improvement in quality, to about 0.95 per cent, resulting from the replacement of the defectives found in the samples by good items can be neglected.) It is also true that if lots of 500 which contain ten per cent defectives are submitted, they will be accepted only one time out of 25. But the percentage of defectives that probably will be passed in the long run will then be ten per cent. Those few lots which are accepted will still be ten per cent defective since nothing will have been done to them except to look at them. (This is often the case, for example, when rejected lots are returned to a supplier.)

If, on the other hand, rejected lots are 100 per cent inspected and all defectives are removed and replaced with good pieces, the quality after inspection will average only 0.4 per cent defective (one lot with ten per cent defectives plus 24 lots with 0 per cent defectives). With 100 per cent inspection of rejected lots and replacement of defectives, the average outgoing quality (after inspection) for various incoming quality levels (before inspection) is shown in Table 1.

Notice that the average outgoing quality reaches a maximum value of 1.68 per cent when the incoming quality is $3^1/_4$ per cent defective. This is called the Average Outgoing Quality Limit (AOQL) for this particular sampling plan. If the incoming quality is either better or worse than $3^1/_4$ per cent, the average outgoing quality will, in the long run, be less than the AOQL.

Table 1
Average Outgoing Quality

AQL = 1%
Sample Size = 50
Acceptance Number = 1

Incoming Quality (% Defective)	Fraction of Lots Accepted	Fraction of Lots Rejected & Screened	Average Outgoing Quality (% Defective)
0	1.00	0	0
1	0.91	0.09	0.91
2	0.73	0.27	1.46
3	0.55	0.45	1.65
$3^1/_4$	0.52	0.48	1.68
4	0.40	0.60	1.60
5	0.28	0.72	1.40
6	0.20	0.80	1.20

To sum up, the quality of lots after sampling inspection is a function of the quality of lots submitted to sampling inspection. If rejected lots are not screened, the outgoing quality is essentially unchanged from the quality submitted. If rejected lots are screened and defectives replaced, significant improvement can be made in the outgoing quality, and the percentage of defectives which probably will be passed in the long run will not be greater than the AOQL.

Notes on Books Received in Engineering Societies Library

REVIEWS OF BOOKS

High Temperature

High Temperature—A Tool for the Future

Proceedings of a symposium held at Berkeley, Calif., June 25–27, 1956. Stanford Research Institute, Menlo Park, Calif., 1956. Cloth, 8 × 10 in., illus., tables, 218 pages, $5.

Reviewed by John A. Clark[1]

This uniquely edited volume compiles the 36 papers presented at a symposium on high-temperature technology at the University of California, Berkeley, late in June, 1956. Sponsors of this symposium were the Stanford Research Institute and the University of California with support from the Air Force OSR, US ARDC, the National Science Foundation, the ONR, and the OOR, all of whom acted as cosponsors. Professors Leo Brewer and A. W. Searcy of the University of California and N. K. Hiester of the Stanford Research Institute were co-chairmen.

The papers presented in this volume are about equally divided among the major topics discussed: Methods for Reaching

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High Temperatures, Materials for Containing High Temperatures, and Processes Occurring at High Temperatures. In addition to publishing the technical papers, the questions asked of the authors and panelists and their answers are presented as an appendix. The keynote address, "Aerodynamic Heating—The Temperature Barrier in Aeronautics," delivered by Theodore von Karman, also is to be found in the book. A most excellent editing job includes large, clear photographs of many of the authors and the panel members taken during the presentation and discussion of the papers. This provides an unusually interesting background to a reader and it is to be hoped that the future symposiums on this and other topics may follow this technique.

What constitutes "high temperature" is, of course, a somewhat relative question, as is brought out by several of the authors. However, for purposes of description, this symposium in the main, considered temperatures in the range of approximately 4000–50,000 K, a region where experimental physicists currently are working. Much higher temperatures obtained in controlled and enclosed experiments are mentioned, perhaps among the most notable being those reported by Heinz Fischer of the Cambridge Research Center (USAF). In his own experiments he reports gas temperatures in excess of 250,000 K at 30 atm in helium using a coaxial capacitor discharge for a pulse duration of 1 mu sec. These temperatures are measured by radiation techniques assuming blackbody radiation and thermal equilibrium. Fischer reports similar Russian experiments using deuterium where maximum gas temperatures were estimated to be in the vicinity of 10^6 K. Considerably higher temperatures are achieved through short duration (nuclear) bomb explosions in space but these are naturally of a more limited experimental value as a source for high temperatures.

Most of the papers presented are descriptive in nature or are reviews of the state of the art. This, however, does not detract from the importance and value of the book. The general lack of detailed analytical papers possibly results from the newness of the subject and the yet undefined character of many of the processes and mechanisms of very high-temperature systems. A definite "pioneer" flavor is evident from several of the papers, particularly, those dealing with the behavior and properties of matter at extreme temperatures. It is quite likely that government security regulations also have influenced the amount of detail that could be included in the papers presented by scientists from military sponsored laboratories. However, there is a wealth of valuable information for engineers and scientists working in many areas of the high-temperature field. Doubtless, this volume will continue to be an important source-book for material on high temperatures and will prove to be a great service to students and others who are beginning to work in this field. We may hope for a second such meeting and publication of its proceedings.

Appropriate to the subject discussed at this symposium, but prepared subsequent to it, is a paper concerned with the fundamental concepts and definition of temperature. It is entitled "Temperature—Its Definition and Measurement," and is written by Carstens Steffens, a senior scientist at the Stanford Research Institute. This paper would have been an ideal kick-off paper to the conference, it would seem, and many may prefer to read it first before looking into the other papers. Temperature, Dr. Steffens points out, is an equilibrium concept and a given system may have several "temperatures," each describing a particular energy configuration of the system. Hence a gas, for example, may have a translational, rotational, vibrational, electronic excitation, and ionization temperature if each of the modes of energy distribution exist in the gas. Each temperature refers to the degree of freedom involved in the description of an energy state. Engineering systems often are conveniently described by a single temperature such as the (total) radiation temperature, color temperature, and the kinetic (translational) temperature. When thermodynamic equilibrium exists in the system, all these temperatures coincide and a detailed examination of the molecular and atomic mechanisms involved is unnecessary. However, when a nonequilibrium system is to be described by a temperature, then an analysis of the details of the particle mechanics is required.

It will not be possible to review each of the papers here, nor would it be desirable. Instead, a brief examination of the major subjects will be presented. The first section of the symposium dealt with methods for reaching high temperatures and was divided into three discussion panels for presentation. Each panel presented four papers. This section includes papers treating solar furnaces and solar radiation, the carbon-arc furnace, high temperatures obtained by electrical discharges, electrical resistance and induction heating, the behavior of matter at high temperatures, chemical methods for obtaining high temperatures, including the combustion of metals, nuclear heat sources, and high temperatures associated with shock waves.

The second section of the symposium examined the subject of materials for containing high temperatures. The panels considered the thermodynamical (static) characteristics of systems and the dynamic or rate-process-type of interaction between systems. First, the panel studied the basic physics and chemistry involved in the description of the structure and properties of substances. In this regard papers were presented on the high-temperatures strength of alloys, ductile ceramics, substances having high melting temperatures, and refractory coatings. Other subjects discussed included salt-liquid metal-phase equilibria, selection of materials for containing high temperatures, correlation of thermodynamic and thermostatic measurements to yield equilibrium data, metal-environment reactions at high temperature, refractory corrosion by liquids, kinetics of fused salts, and behavior of high-temperature materials in an environment of high (neutron) radiation densities.

The third and final section of the symposium directed its attention to processes occurring at high temperatures. Panels for this section were devoted to a discussion of papers on reaction-rate studies, physics of the liquid and solid state, chemical reactions in the condensed state, chemistry at high temperature and high pressure, physical chemistry of the interactions between gases and liquid and solids, vapor deposition of high-temperature coatings, and the use of the mass spectrograph in high-temperature vaporization studies. The final paper in this panel surveyed the present status of electromagnetic levitation as a high-temperature research tool. This interesting technique enables the supporting and heating of liquid and solid conducting masses without the use of physical, structural supporting members or surfaces. It is quite new and is in need of further development but appears to be suitable for the study of the physical properties of conductors at high temperatures.

High-temperature technology has introduced a new word into scientific terminology. This word is "plasma" or "thermal plasma" and it describes what is now sometimes identified as a fourth state of matter. This is the very high-temperature state (greater than, say, 7000 K) where all known physical substances are gaseous and are to some degree ionized. At 30,000 K, for example, 60 per cent of the particles of a mass of nitrogen have become free electrons and represent a practically mass-less gas. The substance is highly conducting and has undergone a complete change in its

physical structure from an original state of 300 K. This means that an understanding of the properties and behavior of high-temperature systems will necessarily demand knowledge of the laws of atomic physics. Not only will dissociation effects need to be considered by the engineer in his treatment of high-temperature substances (gaseous, plasma states) but he also will have to consider and account for the effects of thermal ionization. What influence this is to have on engineering education remains to be seen but an increase in basic atomic physics and physical chemistry course work seems inevitable, if the engineer and technological development are to keep pace with scientific discovery. Wolfgang Finkelnburg of the Siemens-Schuckert Research Laboratory, Erlangen, Germany, has summarized this new challenge to engineers in his paper with the observation: "Physicists thus come in contact with such states of matter that heretofore have been considered mainly by theoretical astrophysicists. It will be interesting to see how quickly the engineer follows the physicist in this new domain."

Turbomachinery

Principles of Turbomachinery

By D. G. Shepherd. The Macmillan Company, New York, N. Y., 1956. Cloth, 6 × 9 in., indexes, references, figs., problems, ix and 463 pp., $10.

Reviewed by R. G. Folsom[2]

Subject matter in courses and textbooks in engineering tends to follow historical developments. Such methods of approach are not always the most effective ones to be used after knowledge in a given field reaches a definite stage of development. These general comments apply specifically to the field of pumps, turbines, and compressors; the usually available books and courses treat each one of these units as though it were unique in itself. The textbook under review has discarded the historical approach and presents a treatment of turbomachinery as a whole, independent of the fluid passing through the machine and emphasizing points of similarity. The author presupposes that the reader knows the fundamentals of thermodynamics and fluid flow, corresponding to that usually expected of third-year students in an engineering curriculum. The first five chapters of the volume are devoted to reviewing and expanding the engineering science phases basic to turbomachinery as a foundation for the art and skill of engineering pertinent to the material presented in the latter sections of the book.

Following an initial brief introductory chapter, including descriptions and photographs of typical turbomachinery equipment, the author presents a chapter on dimensional analysis, which stresses the physical interpretation of conditions of similitude resulting in the dynamically similar operation of geometrically similar equipment. The importance of specific speed as a type characteristic and the affinity laws for performance prediction are treated. Variations due to Reynolds number and compressible flow are considered. In the next chapter on energy transfer, the author develops the unidimensional classical Euler equation from a basic application of Newton's laws of motion to an ideal radial-flow machine and presents the classical performance characteristic curves for such turbomachines, under the assumption that all fluid follows the mean blade shapes. The same basic treatment is applied to axial-flow units. The fourth chapter is concerned with the thermodynamics of gas flow and treats situations important to compressors.

The chapter on fluid flow reviews the fundamentals and extends the concept and treatment of basic fluid flow as required in the many situations existing in turbomachines. Turbulence, flow through differently shaped channels and about differently shaped objects, compressibility, cavitation, theoretical corrections for two-dimensional flow, three-dimensional flow phenomena, free and forced vortexes, and surging are among the subjects treated.

Up to this point the book includes problems to be worked by the student. The author's emphasis in these chapters is on an explanation of the physical phenomena, not on a description of what the flow is and how it occurs. No problems are presented for the remainder of the text since the material is in the area of design; the particular design problems that should be tackled depend on the experience of the instructor. An adequate number of useful references is included at the end of each chapter throughout the book.

The sixth chapter is devoted to radial-flow centrifugal pumps and compressors. Theoretical considerations for the deviations in two-dimensional flow from the ideal-unit dimensional Euler flow are developed, with a detailed explanation through flow visualization experiments of actual flow conditions throughout the centrifugal machine from inlet, with possible prerotation, to flow in the volute case with losses throughout the circuit. The practical effects of Reynolds number and Mach number on characteristic performance curves are included, as well as series and parallel operation problems associated with surging and cavitation.

The chapter on radial-flow turbines considers the inward-flow turbine for a compressible fluid, such as steam, and the inward-flow hydraulic turbines, with a discussion of specific speed, cavitation, efficiency, and performance. The author includes a treatment of the Banki turbine, although it has very limited commercial application.

The chapter on axial-flow turbines considers blade and nozzle efficiencies in detail, as well as stage performance, using steam and gas. Multistaging impulse and reaction blading, the influence of Reynolds number and Mach number, three-dimensional flow with losses, are included. The Kaplan hydraulic turbine is included and the Pelton impulse wheel also is included in this section, a classification which is not common.

The ninth chapter is devoted to a discussion of the performance of turbines and a study of a comparison of various types. Part- and full-load performance and efficiency of steam turbines, hydraulic turbines, and gas turbines, as well as the matching of turbine and compressor characteristics, are included. The chapter ends with a recapitulation of the comparative performance of axial-flow and radial-flow turbines.

The chapter on axial-flow compressors and pumps presents the principal design procedures for this equipment. The blade-element theory, making use of airfoil sections in cascades, is presented in some detail. Consideration is given to stagger, blade profile, reaction blading, axial velocity distributions, real test-flow patterns, and stalling and surging phenomena. Supersonic compressors and axial-flow liquid pumps are included.

The last chapter is devoted to the overall characteristics, estimation of performance, a discussion of performance limits for axial-flow compressors, and a comparison of the performance of both axial and radial-flow compressors, and pumps. A name index and an extended subject index enhance the value of the book.

This textbook presents a generalized treatment of the fundamental fluid-flow and thermodynamic phenomena involved in turbomachinery, and the application of these principles to several kinds of turbomachinery, with a detailed discussion of major nonmechanical design factors and performance characteristics of actual machines. No consideration of the design from a mechanical standpoint is presented. The book can be recommended

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for use in a senior or first-year graduate course in turbomachinery, to develop in the student an understanding of the fundamental phenomena associated with turbomachinery, with enough treatment of practical factors so that the student would be in a position to understand and to compare the operation, performance, and use of various units. Practicing engineers interested in reviewing and bringing up to date their knowledge of turbomachinery will find this textbook valuable.

BOOKS RECEIVED IN LIBRARY

ASTM Standards on Plastics
Published 1957 by The American Society for Testing Materials, Philadelphia, Pa. 856 p., 6 × 9 in., paper. $6. Of the 40 specifications, 93 test methods, 19 recommended practices, and 5 definitions, 34 are new or revised. They cover mechanical, thermal, optical, and performance properties of plastics. Standards are included for molding compounds, shapes, and molds, as are also methods for analytical and electrical testing.

Acoustical Engineering
By Harry F. Olson. 1957, D. Van Nostrand Company, Inc., Princeton, N. J. 718 p., 6 × 9¼ in., bound. $13.50. About one third larger than the author's "Elements of Acoustical Engineering" 1947, on which it is based, the present volume has been revised throughout and includes two new chapters on complete sound reproducing systems, and means for the communication of information. Dealt with in other chapters are subjects such as ultrasonics, underwater sound, speech, music, hearing, transducers, microphones, loudspeakers, and acoustical radiating and mechanical vibrating systems. References are scattered throughout the book.

Annual Report on the Progress of Rubber Technology, Vol. 20
Edited by T. J. Drakeley. 1957, Institution of the Rubber Industry, London, England. 141 p., 7⅛ × 10 in., bound. £1 5s. This selective review of the developments and literature of 1956 has separate papers on a wide variety of rubber goods for industrial and other uses. There is a general historical and statistical review of the year, also papers on planting, production, properties, compounding ingredients, testing, and the chemistry and physics of rubber and latex.

Aspects of River Pollution
By Louis Klein. 1957, Academic Press, Inc., New York, N. Y. 621 p., 5¾ × 8¾ in., bound. $14.50. This extensive study is divided into 15 chapters, each devoted to a particular aspect of the subject: nature and effect of pollution; causes; uses of river water; physical characteristics of rivers; sewage disposal and purification; disposal and treatment of trade wastes; etc. Each chapter is provided with a list of references to more detailed treatment of specific subjects, the number of references cited totaling over 1300. Though the book deals mainly with British practice, most of the subject matter has application in other countries.

Automatic Digital Calculators
By A. D. Booth and K. H. V. Booth. Second Edition, 1956. Academic Press Inc., Publishers, New York, N. Y. 261 p., 5½ × 8¾ in., bound. $6. An introduction to the theory, design, construction, and use of digital calculators, intended for engineers new to the field. The book has been revised to include information on automatic coding procedures and on new circuit elements such as the transistor and the ferro electric matrix store. The bibliography is more than twice as long as that in the first edition.

Differential Equations Applied in Science and Engineering
By Harold Wayland. 1957, D. Van Nostrand Company, Inc., Princeton, N. J. 353 p., 6 × 9¼ in., bound. $7.50. A clear, systematic development of the interrelation of classical analysis and those physical concepts in science and engineering which can be described in terms of differential equations. Separate chapters are devoted to power series solutions, Fourier series and orthogonal functions, boundary value problems, and integral transforms. The translation of physical concepts into mathematical language is analyzed, and the reasonableness of the solution is considered.

Disposal of Industrial Waste Materials
Papers read at a Conference, April, 1956. 1957, Society of Chemical Industry, London, England. 157 p., 8¾ × 11½ in., bound. $7.50. Available in the United States from Macmillan Co., New York, N. Y. These are papers by various authors dealing with waste treatment in a number of industries including the pharmaceutical, pesticides, leather, rubber, resins, paints and varnishes, textiles and paper, ceramic, iron and steel, nonferrous metals, electroplating, and petroleum industries. The problems, origin, treatment for re-use and recovery of valuable material, and the final disposal of both liquid and solid residues is discussed. There are two papers on the disposal of industrial atomic wastes and the industrial uses of fission products.

Elektrische Messung Mechanischer Grossen
By Paul M. Pflier. Fourth Edition, 1956. Springer-Verlag, Berlin, Germany. 276 p., 6⅛ × 9¼ in., bound. DM 33.00. A thorough treatment of the electrical measurement of mechanical constants and quantities. The first two sections deal with the fundamentals of electrical measuring devices and the examination of their applicability to the determination of mechanical quantities. The third section demonstrates detailed procedures for the measurement of length, power, speed, acceleration, vibration, shock effects, and time.

Engineering Enrollment in the United States
Edited by Norman N. Barish. 1957, New York University Press, New York, N. Y. 226 p., 6¼ × 9½ in., bound. $7.50. Presents basic statistics on the subject in both tabular and graphic forms. The period covered varies but generally includes the last 25 to 35 years. In addition to general coverage there are chapters on all major fields of engineering, and one chapter on engineering training in Russia. Considers the effects of proliferation of curriculums in engineering specialties, large-scale enrollment in graduate study, and attrition of engineering students. Concludes that the current shortage of engineering talent is critical with respect to engineers with a high degree of mathematical and scientific orientation, and unusual analytic and design creativity.

Heizung-Luftung-Klimatisierung
VDI Berichte, vol. 21. 1957, Verein deutscher Ingenieure-Verlag, Düsseldorf, Germany. 68 p., 8¼ × 11⅝ in., paper. Price not given. Three papers and two round-table discussions from a 1956 conference on air conditioning cover the following topics: flow phenomena in artificially ventilated rooms; radial and convection heating; heat requirements for houses with different methods of ventilation; inspection requirements for air-conditioning equipment; and economy of various fuels in hot-water-heating installations.

Inventors and Inventions
By C. D. Tuska. 1957, McGraw-Hill Book Company, Inc., New York, N. Y. 174 p., 6 × 9¼ in., bound. $3.75. This manual for present and potential inventors includes: the inventions of primitive man; the relation of environment, education, age, sex, methods, and psychology to invention; patentable inventions; and the marketing of inventions. Some outstanding inventions are covered by the case-study approach. A few sample patents cases and decisions are presented in an appendix.

Locomotive Cyclopedia of American Practice
15th Edition, 1956. Published by Simmons-Boardman Publishing Corporation, New York, N. Y. 728 p., 8⅜ × 11¼ in., bound. $12. The 15th edition is devoted primarily to diesel-electric locomotives with some coverage of electric and turbine-electric locomotives. The coverage of steam locomotives is limited to a small section. The dictionary has been revised to include only terms relating to the first three types of motive power. The major components such as engines, fuel, lubricating and cooling systems, and brakes, are covered as well as maintenance facilities. An entirely new section on electrical fundamentals has been added.

Manual on Industrial Water
(Special Technical Publication No. 148-B). Published 1956 by the American Society for Testing Materials, Philadelphia, Pa. 492 p., 6 × 9¼ in., bound. $6. In addition to a comprehensive discussion of the uses, treatment, sampling, analysis, and difficulties caused by water, the Manual contains a complete appendix listing ASTM standards relating to industrial water. Five methods of sampling, 41 standards, 4 methods of analysis, three standards for reporting results, 6 standards for methods of testing, a glossary of terms, a list of industrial water requirements, and a bibliography are included. Among these are 7 new methods and one important revision.

Modern Pulp and Paper Making
Third Edition Revised and Edited by John P. Calkin. 1957, Reinhold Publishing Corp., New York, N. Y. 549 p., 6 × 9¾ in., bound. $10. A revision of the previous editions by George S. Witham, this third edition has been rewritten by authorities in the field. Full coverage is given to such subjects as: papermaking materials and processes, varieties of paper and paperboard, the sulfite process, the alkaline processes, pulp bleaching, the machine and finishing rooms, paper defects, testing of paper and paper materials, process instrumentation for the pulp and paper industry. References are included.

Motion Economy and Work Measurement
By Robert Lee Morrow. 1957, The Ronald Press Company, New York, N. Y. 468 p., 6 × 9¼ in., bound. $7.50. This revision of the book previously published under the title "Time Study and Motion Economy" has been expanded to include application of

motion study to office work, micromation study, use of film in motion study, motion time standards, work sampling (ratio delay), fatigue measurement, and recent material in connection with automatic machines. Emphasis is on application and theory for application. Charts, graphs, and tables are extensively used to illustrate the text material.

National Plumbing Code Handbook
Edited by Vincent T. Manas. 1957, McGraw-Hill Book Company, Inc., New York, N. Y. Various pagings, $5^1/_2 \times 8^1/_4$ in., bound. $7.50. By illustration and explanatory text this handbook interprets the American Standard National Plumbing Code, ASA A40.8–1955. Practical code regulations are covered in the first two parts of the book while part 3 covers those phases of hydraulics and pneumatics which are inherent in plumbing systems, such as: Demand and discharge rates of plumbing fixtures; design loads for plumbing systems, capacities of plumbing stacks, and of sloping drains; and strength of buried conduits under earth loads.

Nuclear Reactors for Research
Edited by Clifford K. Beck. 1957, D. Van Nostrand Company, Inc., Princeton, N. J. 267 p., $6^1/_8 \times 9^3/_8$ in., bound. $8.50. In this third volume in The Geneva Series on The Peaceful Uses of Atomic Energy, part 1 contains the following sections: The kinds of institutions that may wish to build and install a research reactor, and their fields of research; technological factors affecting choice; performance data, safety considerations and the uses of research reactors in physics, chemistry, engineering, and biology. Part 2 describes research reactor projects of all types now in operation at specific locations in Europe and America, including Russia. The book provides a list of the papers relevant to research reactors presented at the 1955 Geneva Conference, a subject index, and a name index.

Properties of Petroleum Reservoir Fluids
By Emil J. Burcik. 1957. John Wiley & Sons, Inc., New York, N. Y. 190 p., $5^3/_4 \times 9^1/_4$ in., bound, $7.50. The purpose of this textbook is to describe certain fundamental concepts on which the art of petroleum engineering is based. Reservoir fluids are defined and their deviation from simple, ideal fluid system behavior is discussed. There are chapters on the hydrocarbons which constitute petroleum, behavior of hydrocarbons in the gaseous state, phase behavior of liquids, qualitative and quantitative phase behavior of hydrocarbon systems, description and applications of reservoir fluid characteristics. The book includes sample calculations and data, tables, and correlation charts for solving many problems encountered in this phase of petroleum technology.

The Prospects of Nuclear Power and Technology
By Gerald Wendt. 1957, D. Van Nostrand Company, Inc., Princeton, N. J. 348 p., $5^3/_4 \times 8^1/_2$ in., bound. $6. A nontechnical report on the present status of nuclear fission, and an appraisal of the future of our society in a nuclear age. Part 1 gives a comprehensive picture of actual and future atomic energy plants here and abroad, the legal and economic factors involved, and the social consequences. Part 2 covers the technology of the nuclear industries and the problems which have arisen. The processing, extraction and disposal of fission products, and future prospects are discussed in this part.

Recent Advances in Science
(Physics and Applied Mathematics.) Edited by M. H. Shamos and G. M. Murphy. 1956, New York University Press, New York, N. Y. (Distributed by Interscience Publishers, New York, N. Y.) 384 p., $6 \times 9^1/_4$ in., bound. $7.50. Twelve lectures, by acknowledged experts, designed to convey to nonspecialists the basic ideas in such areas of science as cryogenics, ferromagnetism, microwave spectroscopy, operations research, and transistor physics. The lectures were delivered at a symposium held at New York University in 1954.

LIBRARY SERVICES

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

Statistical Methods in Quality Control
By Dudley J. Cowden. 1957, Prentice-Hall, Inc., Englewood Cliffs, N. J. 727 p., $6 \times 9^1/_4$ in., bound. $12. The first 12 chapters are mainly on statistical methods with illustrations from the field of quality control. The subjects covered include: statistical data, elementary principles of probability, binomial and multinomial distributions, normal distribution, and analysis of variance. Chapters 13 through 29 are concerned mainly with process control including specification limits and tolerances, use of control charts for variables, and for nonnormal distributions, selected techniques for analysis of defectives and the Poisson distribution. Chapter 29, dealing with the economics of control charts contains some original methodology. Chapters 30 through 40 deal mainly with product control containing such subjects as hypergeometric distribution; single, double, and sequential sampling; and analysis of the pattern of variability.

Sterilization in Food Technology
By C. Olin Ball and F. C. W. Olson. 1957, McGraw-Hill Book Company, Inc., New York, N. Y. 654 p., $6 \times 9^1/_4$ in., bound. $16. This book describes the sterilization of food by lethal energy. The history of food preservation, water process, and steam process engineering in food sterilization; the resistance of yeast, molds, and bacteria to heat; and the mechanism of heat transfer in food and food containers are included. The book traces the development of a mathematical method for predicting the effects of sterilization, both in relation to the death of micro-organisms, and the destruction of nutritive qualities of food such as vitamins and minerals.

Technische Stromungslehre
By Bruno Eck. Fifth Edition, 1957. Springer-Verlag, Berlin, Germany. 422 p., $6^1/_8 \times 9^1/_4$ in., bound. DM 29.40. This treatise on hydrodynamics covers the basic principles of various types of flow at considerable length, with particular attention to the influence of friction. These principles are then utilized in the analysis of blade and propeller action, air foils, cavitation, etc. The motion of solid bodies in a flowing medium, such as in dust collectors and pneumatic conveyers, is considered. There is a final chapter on flow-measuring methods and apparatus.

Thermodynamic Functions of Gases
Vol. 1: Ammonia, Carbon Dioxide, and Carbon Monoxide. Vol. 2: Air, Acetylene, Ethylene, Propane, and Argon. Edited by F. Din. 1956, Butterworths Scientific Publications, London, England. Vol. 1, 175 p., vol. 2, 201 p., $6^3/_8 \times 10$ in., bound. 63s per volume. These volumes are the first of a series of volumes dealing with industrial gases. Volume one contains a general discussion of thermodynamic diagrams and functions and their preparation as well as specific chapters on ammonia, carbon dioxide, and carbon monoxide. Volume two covers air, argon, acetylene, ethylene, and propane. For each gas, there is a survey of existing data, calculation of thermodynamic functions and construction of the thermodynamic diagram, and tables of thermodynamic functions.

Viscous Flow Theory
Vol. 2: Turbulent Flow. By Shih-I Pai. 1957, D. Van Nostrand Company, Inc., Princeton, N. J. 277 p., $6^1/_4 \times 9^1/_4$ in., bound. $6.75. This second part of a two-volume work on viscous flow deals with the fluid dynamics of turbulence. Two different approaches to the study of turbulent flow are used: the semi-empirical or phenomenological theory of both incompressible and compressible fluids, and the statistical theory. Such topics as probability distribution, random walk, correlation tensor, spectrum, and their relations to turbulence are discussed. Also covered are turbulent diffusion, locally isotropic and non-isotropic turbulence, and turbulence in a compressible fluid flow, and in magnetohydrodynamics.

ASME BOILER AND PRESSURE VESSEL CODE

Interpretations

THE Boiler and Pressure Vessel Committee meets regularly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th

STRESS VALUES FOR CASE NO. 1122-6

Alloy Material	Spec Min Tensile	−20 to 100	200	300	400	500	600	650	700	750	800	850
		For Metal Temperatures Not Exceeding Deg F										
Type 304L (T.S.)*	70000	17500	17000	16000	15000	14000	13000	12500	12000	11500	11000	
Type 304L (Y.S.)	70000	17500	15300	13100	11000	9700	9000	8750	8500	8300	8100	
Type 316L (T.S.)*	70000	17500	17500	15800	14750	14000	13600	13450	13250	13000	12700	12250
Type 316L (Y.S.)	70000	17500	16250	14500	12000	11000	10150	9800	9450	9100	8800	8500

* Due to the relatively low yield strength of this material, the higher stress values at temperatures from 200 F through 850 F were established to permit the use of this material where slightly greater deformation is acceptable. The stress values within the above range exceed 62½ per cent, but do not exceed 90 per cent of the yield strength at temperature. These stress values are not recommended for the design of flanges or piping.

Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting November 1, 1957, and approved by the Board on December 23, 1957.)

Case No. 1122-6

(Reopened) (Special Ruling)

(ELC Stainless Steels)

Inquiry: May the extra-low-carbon grades of the austenitic stainless steels Types 304 and 316 be used under the applicable Code rules pertaining to the regular grades of austenitic stainless steels?

Reply: It is the opinion of the Committee that the extra-low-carbon grades of Types 304 and 316 may be used for construction under the Code rules applying to the regular grades of Types 304 and 316 with the following modifications:

(1) The material shall conform to the requirements of an approved specification which covers the same grade with regular carbon content, except that:

(a) The carbon content shall be limited to 0.03 per cent max.

(b) The mechanical properties shall be as follows:

Tensile strength	70,000 psi min
Yield strength	25,000 psi min for Type 304L 30,000 psi min for Type 316L
Elongation in 2 in.—as required by specification	

(c) The stress values in tension (see accompanying table) are to be used for vessels under internal pressure.

(2) The extra-low-carbon grades of austenitic stainless steels Types 304 and 316 may be used for the construction of vessels under external pressure under the Code rules applying to the regular grades of Types 304 and 316.

(a) The material shall conform to Pars. (1) (a) and (b) above.

(b) The required thickness of shells and heads, and the required moment of inertia for stiffening rings, shall be determined from the chart in Fig. UHA-28.3 for Type 304L, and from the chart in Fig. UHA-28.4 for Type 316L.

Note: Revise the bracketed note under Fig. UHA-28.4 to read: "(18G-8NitMo-0.03 Maximum Carbon Type 316L)."

Case No. 1199-1

(Reopened) (Special Ruling)

(Non-Metallic Construction)

Add the following explanatory note at the end of the reply:

Note: This Case is not intended to apply to shell and tube type heat-exchange equipment.

Case No. 1222-1

(Reopened) (Special Ruling)

(Use of SB-178, Grade GM40A for Unfired Pressure Vessels)

Add the following new subparagraph to the Reply to read:

(8) The Chart in Fig. UNF-28.19 shall be used in applying the rules for the design of vessels under external pressure.

(Copies of Fig. UNF-28.19 are available on request from the Secretary of the ASME Boiler and Pressure Vessel Committee, 29 West 39th St., New York 18, N. Y.)

Case No. 1234

(Special Ruling)

(Nuclear Reactor Vessels)

Inquiry: Under what special rules shall a nuclear reactor vessel or a primary vessel, as defined in Case No. 1224, be built in order to be acceptable for Code construction?

Reply: Pending development of more complete rules to cover nuclear vessels, it is the opinion of the Committee that a reactor vessel or a primary vessel shall meet the requirements of this Case in order to meet the intent of the Code and to be stamped in accordance with Case No. 1224. Where differences exist the requirements of this Case take precedence over the Code rules for the subjects covered.

The requirements of this Case are as follows:

(1) The thickness of each part of the vessel shall not be less than that determined by the Code rules using the applicable formula for the part with S values from the appropriate table in Section I or Section VIII.

(2) The combination of stresses evaluated under item (1) with thermal stresses due to temperature distributions at any level of steady power operation, including internal heat generation, shall not exceed 1½ times the S value.

(3) For operating metal temperatures up to 800 F the maximum allowable bolt design stresses as used in Code formulas may be based on heat treated properties for operating metal temperatures 100 F or more below the tempering temperature, provided the stresses do not exceed ⅓ of the yield strength at temperature.

(4) Due regard shall be given to the creep and stress-rupture properties for prolonged exposure at temperature in order to assure adequate safety under all conditions of operation.

(5) (a) Compensation shall be made for all openings, regardless of diameter. The compensation shall be on either the reinforcement basis or the ligament efficiency basis as given in Section I or Section VIII.

Any compensation required shall be integral with the vessel wall or the nozzle or some with each.

(b) When all or part of the required compensation is attributable to the nozzle, the nozzle shall be attached by full penetration welds through either the vessel or the nozzle thickness. When no portion of the nozzle is required for opening compensation, the nozzle need not be attached by full penetration welds, except as limited by (d).

(c) Each design detail shall be carefully considered to provide against operational failure such as might occur from thermal stress or external pipe reactions.

(d) It is the intent of the foregoing that full penetration welds be used wherever possible, for the purpose of achieving continuity of metal and facilitating the required radiographic examination. Non-full penetration welds are intended to be allowed only when the spacing of the openings is such as to make the achievement of full penetration welds through the vessel or nozzle walls physically impossible.

(6) All welds which are subject to stress caused by pressure shall be radiographically inspected, except where this is impractical for non-full-penetration welds at close-spaced openings as permitted in item (5). Wherever possible all weld joints shall be designed to permit radiographic examination to Code standards. When the weld joints cannot be designed to permit radiography to Code standards, radiographic examination shall nevertheless be made in accordance with best obtainable practice. In addition, when radiography to Code standards is not feasible or when any radiography is impractical, welds shall be examined by other non-destructive methods such as liquid penetrant, magnetic particle, or ultrasonic, to prove their soundness. None of this item applies to seal welds.

(7) The Code rules are intended to provide minimum safety requirements for new construction, and not to cover deterioration which may occur in service as a result of corrosion, erosion, radiation effects, instability of the material, or operating conditions such as transient thermal stress or mechanical shock and vibratory loading; nevertheless particular consideration shall be given to these effects with a view to obtaining the desired life of the vessel.

(8) In view of these severe service requirements, particular consideration shall also be given to materials, construction, and inspection, including supplementary methods of non-destructive testing, so that soundness and good practice will result. Due regard shall be given to such items as smoothness of welds and to location and detail of structural attachments.

Case No. 1243

(Special Ruling)

(Use of 3½% Nickel Steel Forgings)

Inquiry: Is it permissible to use $3^1/_2$ per cent nickel steel forgings having chemical and physical properties conforming to Specification SA-203 Grade D or Grade E and otherwise complying with Specification SA-336 for construction conforming to Sections I and VIII as modified by the following requirements?

(a) *Heat Treatment* For sections over 3 in. in thickness, the heat treatment may consist of accelerated cooling and tempering to provide a structure comparable to that obtained in lesser thicknesses by normalizing.

(b) *Mechanical Properties* For material over $3^1/_2$ in. in thickness a deduction from the percentage of elongation in 2 in. specified of 0.5 per cent shall be allowed for each increment of $^1/_2$ in. above $3^1/_2$ in. This deduction shall not exceed 3.0 per cent.

(c) *Inspection* All surfaces shall be inspected for injurious defects by magnetic powder or penetrant oil methods.

Reply: (a) In the opinion of the Committee, $3^1/_2$ per cent nickel steel forgings made to the chemical and physical property requirements of Specification SA-203, Grade D or Grade E and otherwise conforming to Specification SA-336 as modified in the inquiry may be used for construction conforming to Sections I and VIII of the ASME Boiler and Pressure Vessel Code.

(b) The allowable stress values given in Table P-7 of Section I and Table UCS-23 of Section VIII for Grades D and E of Specification SA-203, shall be used for the equivalent grades covered by this Case.

Case No. 1244

(Special Ruling)

(Nickel-Iron-Chromium-Moly-Copper Alloy)

Inquiry: May annealed seamless nickel-iron-chromium-molybdenum-copper alloy pipe and tubes with the following chemical analysis and minimum mechanical properties, but otherwise conforming to Specifications SB-163 and SB-167, be used in Code construction under Section VIII?

	CHEMICAL COMPOSITION
Ni (incl Co)	40–44
C	0.10 max
Mn	1.00 max
Fe	26.0–30.0
S	0.03 max
Si	0.50 max
Cu	1.0–2.5
Cr	20.5–23.0
Al	0.50 max
Ti	1.00 max
Mo	2.5–3.5
Cb + Ta	1.00 max
	MINIMUM MECHANICAL PROPERTIES
Tensile Strength	75,000 psi
Yield Strength (2% offset)	28,000 psi
Elongation	35% (in 2")

If so, what design stresses shall be employed at temperatures up to 700 F?

Reply: It is the opinion of the Committee that nickel-iron-chromium-molybdenum-copper alloy seamless pipe and tubes may be used in Code construction provided:

(1) The pipe and tubing meet the chemical analysis and minimum mechanical properties described in the Inquiry and otherwise conform to SB-163 or SB-167.

(2) No welding other than seal welding of this pipe or tubing is employed in production.

(3) The maximum allowable design stress shall not exceed the following:

FOR METAL TEMPERATURES NOT EXCEEDING	DESIGN STRESS
100 F	18,650
200 F	17,100
300 F	16,200
400 F	15,400
500 F	14,800
600 F	14,400
700 F	14,000

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

As NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Unfired Pressure Vessels, 1956

PAR. UG-16(d) *Pipe Under Tolerance* Add a new subparagraph to read:

If pipe is ordered by its nominal wall thickness, as is customary in trade prac-

tice, the manufacturing under-tolerance on wall thickness shall be taken into account. The next heavier commercial wall thickness may then be used. The manufacturing under-tolerances are given in the several pipe specifications listed in the applicable tables in Subsection C. After the minimum pipe wall thickness is determined, it shall be increased by an amount sufficient to provide the manufacturing tolerance allowed in the applicable pipe specification.

PAR. UG-31(c)(3) Delete.

PAR. UG-99(c) Revise to read:

A hydrostatic test pressure of at least $1\frac{1}{2}$ times the maximum allowable pressure as defined in Par. UA-60(c) may be used by agreement between the user and manufacturer, in which case calculations shall be made available to the inspector. The hydrostatic test pressure at the top of the vessels shall be the minimum of the test pressures calculated for each pressure element reduced by the hydrostatic head on that element. When this test pressure is used, the inspector shall reserve the right to require the manufacturer or designer to furnish the calculations used in determining the hydrostatic test pressure for any part of the vessel.

PAR. UG-120(a) Revise to read:

A data sheet shall be filled out on Form U-1 or Form U-1A by the manufacturer and shall be signed by the manufacturer and the inspector for each pressure vessel marked with the Code U-symbol.

FORMS Add Form U-1A, Alternate Manufacturers Data Report Form. (Copies are available from the Secretary of the ASME Boiler and Pressure Vessel Committee, 29 West 39th Street, New York 18, N. Y.)

FORMS U-1 and U-2 In lines 4 and 12 revise "(Fig. or F.B. & lowest T.S.)" to read "(Flg. or F.B. & Spec. Min. T.S.)."

FORM U-3 Under line 6 revise "(brand and lowest tensile strength)" to read "(Flg. or F.B. & Spec. Min. T.S.)."

Welding Qualifications, 1956

PAR. Q-20(b) Revise to read:

The performance test may be terminated at any stage of the testing procedure whenever it becomes apparent to the supervisor conducting the tests that the welder or welding operator does not have the required skill to produce satisfactory results. In this event, the welder or welding operator may be tested at the discretion of the manufacturer in accordance with Par. QN-21.

PAR. QN-20(b) Revise to read:

The performance test may be terminated at any stage of the testing procedure whenever it becomes apparent to the supervisor conducting the tests that the welder or welding operator does not have the required skill to produce satisfactory results. In this event, the welder or welding operator may be tested at the discretion of the manufacturer in accordance with Par. QN-21.

PARS. Q-21(b)(1) and QN-21(b)(1) Revise to read:

A three-foot length of weld made by the operator shall be examined by radiography or by sectioning. The length of weld so examined may be that of a test plate or of production welding.

PARS. Q-21(b)(2) and QN-21(b)(2) Revise as follows:

In order to assure that the operator can carry out the provisions of the welding procedure, the radiographs of the joint shall be made in accordance with the technique prescribed in Par. UW-51 of Section VIII and shall meet the standards for spot radiographic examination given below, or two transverse sections, taken at approximately the third points of the weld, shall meet the standards for sectioning given below:

(a) Standards for spot radiographic examination:

(1) Welds in which the radiographs show any type of crack or zone of incomplete penetration shall be unacceptable.

(2) Welds in which the radiographs show slag inclusions or cavities shall be unacceptable if the length of any such imperfection is greater than $\frac{2}{3}$ T where T is the thickness of the thinner plate welded. If several imperfections within the above limitations exist in line, the welds shall be judged acceptable if the sum of the longest dimensions of all such imperfections is not more than T in a length of $6T$ (or proportionately for radiographs shorter than $6T$) and if the longest imperfections considered are separated by at least $3L$ of acceptable weld metal, where L is the length of the longest imperfection. The maximum length of acceptable imperfection shall be $\frac{3}{4}$ in. Any such imperfections shorter than $\frac{1}{4}$ in. shall be acceptable for any plate thickness.

(3) Porosity shall meet the required standards of Appendix IV of Section VIII.

(b) Standards for sectioning:

(1) When the welded joint is to be examined by sectioning, the specimens removed shall be such as to provide a full cross section of the welded joint and may be removed by trepanning a round hole or by any equivalent method.

(2) The specimens shall be ground or otherwise smoothed and then etched by any method or solution which will reveal the defects without unduly exaggerating or enlarging them. (See Appendix K of Section VIII.)

(3) If sections are oxygen-cut from the vessel wall, the opening in the vessel wall shall not exceed $1\frac{1}{2}$ in. on any diameter, or the width of the weld, whichever is greater, as measured after removal of all loose scale and slag accumulation. Oxygen-cut specimens shall be sawed across the weld to obtain a plane surface which will expose the full width of the weld on the cut surface.

(4) Sections removed from the welded joint shall not show any types of cracks or zones of incomplete fusion or inadequate joint penetration. Gas pockets and slag inclusions shall be permissible only:

(a) When the width of any single slag inclusion between layers of weld metal substantially parallel to the plate surface is not greater than one-half the width of the sound weld metal where the slag inclusion is located; and

(b) When the total thickness of all of the slag inclusions in any plane at approximately right angles to the plate surface is not greater than 10 per cent of the thickness of the thinner plate; and

(c) When there are gas pockets that do not exceed $\frac{1}{16}$ in. in greatest dimension and when there are no more than six gas pockets of this maximum size per square inch of the weld metal or when the combined areas of a greater number of pockets do not exceed 0.02 sq in. per square inch of weld metal.

(5) The segments or plugs after removal shall be properly stamped or tagged for identification and, after etching, kept in proper containers, with a record of their place of removal as well as of the welding operator who performed the welding.

PARS. Q-21(b)(4) and QN-21(b)(4) Add a new Par. (4) to read:

(4) The results of the radiographic or sectioning examination shall be recorded and the radiographs or sectioned specimens may be retained or be discarded by the manufacturer.

PARS. Q-26 AND QN-26 Revise to read:

Renewal of qualification of a Performance Specification is required (1) when a welder or welding operator has not used the specific process, i.e., metal arc, gas, submerged arc, etc., to weld either ferrous or non-ferrous materials for a period of three months or more, or (2) when there is a specific reason to question his ability to make welds that meet the Specification. Renewal of qualification under (1) need be made in only a single test-plate thickness.

Current Engineering: Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

1956-1957 UET Report High Lights

- *New Engineering Center*
- *Engineering Societies Library*
- *The Engineering Foundation*

THE United Engineering Trustees, Inc., recently released its annual report of the fifty-third year, 1956-1957, of its operation. The report was issued by UET President Walter J. Barrett. The following excerpts are from his report:

General. UET, as the joint corporate agency of the Founder Societies, is the medium for co-operation by the major national engineering societies in matters of common interest. The most recent example of such co-operation in the interest of the profession as a whole is the rapidly materializing plan for the new United Engineering Center; this structure is vitally needed if the engineering societies are to continue to pace the tremendous growth of the engineering profession in a technological age. When the present Engineering Societies Building was dedicated in 1907, the Founder Societies listed membership which totaled 15,539. Today the Founder Societies membership lists (including AIChE) total more than 179,000 and are rapidly growing.

New United Engineering Center. At the beginning of the present fiscal year United Engineering Trustees, Inc., undertook the important responsibility imposed by the Boards of its four Founder Societies which by September, 1956, had approved the recommendation of a Task Committee of Fifteen, appointed in the fall of 1955. The assignment of this committee was to recommend a specific site for a new engineering societies center.

The Trustees inspected a number of sites in New York City and enthusiastically and unanimously agreed on a site including the entire block-front on the west side of United Nations Plaza between 47th and 48th Streets, extending back from United Nations Plaza (First Avenue) 150 ft on East 47th and 225 ft on East 48th Street.

Aggressive steps were instituted to secure this site, and on August 1, 1957, its acquisition was announced to the press, title having been taken to all of the land except one lot approximating 3500 sq ft for which UET has a purchase contract to take title July 1, 1958.

During the early part of 1957, space planning was initiated with the five participating societies and with 15 other additional societies who wish to be associated in the new Center.

Results of the studies pointed to a building of about 250,000 sq ft, which would include the Library, space for interpretive exhibitions of new engineering developments, and meeting rooms, and most importantly, the additional space in various categories that is so urgently needed to serve a growing membership.

Shreve, Lamb & Harmon Associates have been appointed architects for the United Engineering Center Building; Jaros, Baum and Bolles have been appointed mechanical engineers; and Seelye, Stevenson, Value and Knecht have been appointed structural engineers.

Artist's concept of United Engineering Center superimposed on aerial view of actual site. Demolition commenced early in January.

The entire program is estimated to cost about $10 million, of which approximately $2 million will be available from the resources of UET, Inc., in its Depreciation Fund and the value of the present building.

A fund of $8 million will be needed to complete the Center. It is expected to raise this amount by gifts from industry and from the 280,000 members who constitute the member and associate societies. The industrial program has $5 million as its objective, and the member-giving program is striving for $3 million.

The purchase contracts for the land do not permit breaking ground until the second half of 1958. It is expected that the building will be available for occupancy in late fall of 1960.

Engineering Foundation. The Engineering Foundation is the research department of United Engineering Trustees, Inc. Funds from its own endowment are used primarily to support basic research of broad importance in the fields of interest to the Founder Societies. It also supports work leading to the improvement of engineering education. Over the years the most important function of the Foundation has been to act as a catalyst—selecting a field for research, assisting in the organization of the work, and supplying financial help for the project to encourage major financial support from industry. During the past 40 years, Foundation grants of approximately $1 million have stimulated research valued at nearly $10 million.

Engineering Societies Library. Engineering Societies Library constitutes the most outstanding and thorough collection of engineering literature in the world today. All of the Library's services are available and are used by engineers, scientists, technologists, and industry in this country.

Medal Boards. UET is custodian of two medal awards: The John Fritz Medal Award "for scientific or industrial achievement in any field of pure or applied science," and the Daniel Guggenheim Medal Award for "notable achievements in the advancement of aeronautics."

Recipient of the John Fritz Medal for the year 1958 is John R. Suman as pioneer in the application of engineering principles to the development, production, and conservation of petroleum and natural gas; author; industrial statesman; and one who takes a keen interest and real pleasure in inspiring men to make the most of their talents.

Recipient of the Daniel Guggenheim Medal Award for the year 1957 is Arthur Emmons Raymond for the development of a long line of successful civil and military aircraft, and for notable contributions to aeronautics in public service.

Finance. During the current year numerous advantageous shifts were made in the investment portfolios. The Depreciation Fund investments had a quoted market value of $1,328,900 on Sept. 30, 1956. All of these securities except AT&T stock and some U. S. Government bonds were sold in mid-year and $901,937 was transferred to the United Engineering Center fund; the remaining proceeds from sale of securities were used to purchase U. S. Government 90-day bills. The total market value of the securities in the Depreciation Fund is $502,212, as of Sept. 30, 1957.

In 1931 Edwin H. McHenry died, leaving Engineering Foundation as residual legatee. The last heir died in February, 1956, which makes UET, Inc. for Engineering Foundation the outright beneficiary. The estate has now been closed and received by UET, Inc. on March 7, 1957, at a market value of $408,357.63; this amount has been entered as the book value of the securities. The fund is dedicated to the memory of the donor's wife, Blanche H. McHenry. This generous gift will enable Engineering Foundation to undertake additional projects for the Founder Societies and thus broaden the scope of the Foundation's research activities.

The funds managed by the Corporation were given for specific purposes, in many cases with the provision that the principal remain intact, the income only to be used for research activities of Engineering Foundation, operation of Engineering Societies Library, and so on. These contributory funds are held in a Combined Fund amounting to $1,397,444 book value. The investments are selected for safety and generally retained until maturity or until there is sufficient justification for replacing any item. The rate of the investment amounted to 5.54 per cent on book value during the past fiscal year.

All our securities are held in custody by the Chemical Corn Exchange Bank, Customers' Securities Department. All accounts are audited twice yearly by Haskins and Sells, Certified Public Accountants.

Professional Advisers. The Board of Trustees retains advisers on all phases of its work in order to obtain the best information available.

They are: Financial Counsel, W. Barton Cummings, vice-president, Chemical Corn Exchange Bank; Investment Adviser, Wood, Struthers & Company, M. S. Harrison, Partner; Legal Counsel, Simon Presant; Consulting Architects, Shreve, Lamb & Harmon Associates; Consulting Actuary, George B. Buck; Insurance Counsel, Frank & DuBois; and Auditors, Haskins & Sells, Certified Public Accountants.

To all of these we are deeply grateful for their expert assistance in the handling of our affairs.

ASME representatives include the following: J. L. Kopf (deceased), H. E. Martin, and W. F. Thompson.

Engineering Societies Library

The roots of the Engineering Societies Library are in the early libraries of the Founder Societies—the American Society of Civil Engineers, American Institute of Mining, Metallurgical, and Petroleum Engineers, The American Society of Mechanical Engineers, and American Institute of Electrical Engineers.

Since the Engineering Societies Library was established 44 years ago, the relatively unorganized separate collections have been combined, classified, and indexed, duplication has been eliminated, and engineering publications from all parts of the world have been extensively, but selectively, acquired. The Engineering Societies Library is outstanding in the fields of its Founder Societies—civil, electrical, mechanical, mining, metallurgical, and petroleum engineering. These and all other branches of engineering are covered by the collection which contains 175,000 volumes, 20,000 maps, 5000 translations, 10,000 bibliographies and indexes, and 1500 current periodicals. These are primarily on the level of the graduate and practicing engineer.

This excellent collection is made useful to engineers by the selected and experienced staff of the Library which makes literature searches and bibliographies tailored to the specific requirements of the inquirer. Such work is kept confidential. The Library's staff also prepares bibliographies on subjects of general engineering interest. These may be purchased by anyone.

Translations of engineering and technical articles are made from all languages into good English by expert translators who are familiar with engineering. Photoprint and microfilm copies of library material are made on request.

All of these services are available and are used by engineers, scientists, technologists, and industry in this country and throughout the world. Books are loaned to individual members of the Founder Societies in the United States and Canada.

Engineers learn about new technical

books in the Library through reviews, prepared by the Library's staff, which are published in the journals of the Founder Societies.

Co-operation between the Library and the Engineering Index provides services unmatched elsewhere in the world. All publications received and retained by the Library are made available to the Engineering Index which provides daily and weekly card services, and annual index volumes. Last year 27,000 articles were indexed. The Engineering Index is a published index to periodical articles and reports in the Library. Users of the Index know that any indexed article can be read in, or a photoprint or microfilm copy obtained from, the Library.

Statistics of Library Use. Recorded statistics of the use of the Library during its early years are sketchy, but its use was largely restricted to those who came to the Library in person. By contrast 56 per cent of the use of the Library during the past year was by mail, telephone, and telegraph. The use of most services was greater than the year before, and the total use was higher than that of any previous year.

	1955–1956	1956–1957
Photoprint orders	5,127	5,136
Photoprints	75,627	74,029
Microfilm	364	379
Bibliography orders	467	251
Searches and paid services	124	135
Translations	233	239
Words translated	356,906	450,574
Borrowers	1,262	1,384
Books loaned	1,646	1,799
Telephone inquiries	10,711	11,320
Written replies to inquiries	3,835	4,426
Visitors served—total	18,007	18,611
Nonvisitors served—total	22,123	23,270
	40,130	41,881

Income from services supplied by the Library has more than doubled in the last seven years; however, the rate of increase tapered off somewhat from that of previous years. The use of the Library's paid services is always closely related to business conditions.

Periodicals. Periodicals are important for they report new developments promptly and they cover details and specific subjects not included in books. Periodicals must be continuously reviewed. Those no longer of value are dropped, and others of importance are acquired as needed and as funds permit.

For years the Library has received a few Russian periodicals, but others that were wanted were not obtainable. This situation changed recently; therefore members of the staffs of the Library and the Engineering Index selected ten additional Russian periodicals. These are now being received.

	1955–1956	1956–1957
Periodicals received:		
Subscription	375	368
Exchange	292	315
Gift	772	772
	1,439	1,455

Miscellaneous Activities. The Library Staff prepared reviews of 549 books valued at $4600. The books were received from publishers in many countries. These reviews were supplied to the editors of *Civil Engineering*, *Electrical Engineering*, "Engineering Index," *Journal of the Engineering Institute of Canada*, *Journal of Metals*, *Journal of Petroleum Technology*, MECHANICAL ENGINEERING, and *Mining Engineering*, who selected and published those reviews of interest to their readers. The Library also paid $2385 for books that were not reviewed, and $5013 for periodicals.

New photoprint order blanks were designed, printed, and are now in use. They are helpful in getting required information, and when correctly filled out and received by the Library in duplicate, they reduce clerical work and shorten order-processing time.

The procedure adopted last year of replying to some letters by returning a photographic copy of the inquirer's letter on which appropriate statements have been added by rubber stamps has proved successful. A Verifax copier was acquired for this and other office copying to reduce the work load on the Photostat machine, and to provide replies more promptly.

A large exhibit and the smaller Tel-A-Story exhibit were both shown at meetings of the Founder Societies. Coupon advertisements appeared in the journals of several Founder Societies. These brought 625 requests for information about the Library and its services.

The Engineering Societies Monographs Committee, of which the Director of the Library is chairman, has just re-examined and given final approval of a manuscript previously tentatively approved. Another manuscript recently received is being reviewed now. Royalties received by the Library since the Engineering Societies Monographs series started in 1931 amount to $14,715.46. The agreement between the McGraw-Hill Book Company and the UET covering the Engineering Societies Monographs series was revised and renewed for five years.

W. L. Betts and F. M. Gilbreth represent ASME on the Engineering Societies Library Board.

Engineering Foundation

At the 42nd annual meeting of the Board of The Engineering Foundation, May 3, 1956, grants totaling $56,000 were approved for the support of 28 projects. Estimated industry support for these projects for the current fiscal year is $510,000 or approximately nine dollars for each one dollar contributed by the Foundation.

Owing to the fact that at the beginning of the current fiscal year the Foundation had a cash balance of approximately $33,000, the Board was able to authorize expenditures for research that were $15,000 higher than anticipated available income. This should have reduced the Foundation's unallocated funds to a reasonable level. However, during the year the McHenry bequest of approximately $410,000 came to the Foundation. The income which accumulated from this fund in the interim between the death of the last beneficiary and the receipt of the estate was enough to increase unallocated funds materially. As a result, the Board should have between $70,000 and $80,000 available to support engineering research for several years or until the unallocated funds are again reduced.

Distribution of Foundation Grants. The distribution of Foundation grants among the Founder Societies and independently for the current fiscal year (ending Sept. 30, 1957) was as follows:

	Projects	*Dollars*	*Per cent*
ASCE	6	$11,000	19.6
AIME	9	23,500	41.9
ASME	7	10,500	18.8
AIEE	2	3,000	5.4
Joint	2	6,000	10.7
Independent	2	2,000	3.6
Total	28	$56,000	100.0

High Lights of the Year in Research. A majority of the projects sponsored and supported financially by the Foundation are of the co-operative type to which industry contributes generously, usually supplying most of the financial support. Co-operative research projects are characterized by low overhead and are supervised by committees of leading engineers who volunteer their services. Nineteen of the 28 projects that received financial support from the Foundation during the 1956-1957 fiscal year are of the co-operative type,

and of these nineteen, eight are research projects originally organized by the Foundation. The other eleven are co-operative projects organized and supervised independently of the Foundation but considered worthy of Foundation support.

Of the eight Foundation's co-operative research projects only one (Thermal Resistivity of Soils) was organized and financed to complete a definite program of research in a definite time. The other seven are quasi-permanent organizations operating in an engineering field where much research needs to be done. These probably will not be terminated until far in the future.

Alloys of Iron Research is the oldest of the Foundation's own co-operative projects. It was organized late in 1929. The Welding Research Council followed in 1933. There was then a hiatus of nearly fifteen years before the four civil engineering research councils were organized and started on their distinguished career of research. The latest of the Foundation's own co-operative projects is the Corrosion Research Council, which began to support research Jan. 1, 1956.

Two of the Foundation's research councils in civil engineering recently started special projects which required more funds than the councils had available in their regular research budget. The Foundation made extra grants available to these two councils so that work could begin promptly and so that industrial support could be more readily secured. These projects include the design of concrete floor slabs, started a little more than a year ago by the Reinforced Concrete Research Council (Project 99); and a guide to column specifications, started during the 1956-1957 fiscal year by the Column Research Council (Project 84).

Progress for the fiscal year just ended, of all the projects supported by the Foundation, is summarized in the Annual Report which is published in February and mailed to some 750 leading engineers in the United States and abroad. It seems unnecessary, therefore, to give here any more than a very brief outline of the year's outstanding accomplishments of a few of the projects.

The fifteenth monograph prepared by Alloys of Iron Research (Project 32) was published in June. This volume is of special value to metallurgists and engineers concerned with the behavior of steels at high temperatures as in jet aircraft and missiles. It should also be noted that the quenching program (Project 80), which has lately overcome the experimental difficulties in determining boundary heat conductance in quenching silver spheres, has extended its research program to steel.

Beginning on Oct. 1, 1957, the important Storm Surges project (118), which the Foundation supported almost alone for three years, will be continued by the "International Geophysical Year." This is another example of the value of the Foundation's support of a project that in its early stages was of no interest to either industry or the Government.

The research work on wood poles (Project 109), first submitted to the Foundation in 1954 by ASTM and AIEE, has been extended to five species of poles which have been pressure treated with preservatives. This $250,000 research project at the U. S. Forest Products Laboratory will probably be finished during the coming fiscal year.

On January 1, 1957, the National Bureau of Standards made available $25,000 a year from its own research funds to enable the Corrosion Research Council (Project 110) to double its research program at NBS. A new project, to cost $25,000 a year, on the relation of stress to corrosion was immediately started, supported by the Council and the Bureau.

Public Relations Committee. The Public Relations Committee held a meeting on May 16, and will meet again on October 10. Just prior to the May meeting, the Committee approved a release on a gift of stock to the Foundation by Prof. Orlan W. Boston of the University of Michigan. At the May meeting, it approved a release covering the Board's action on May 16 on grants. This was mailed on May 17.

At the May meeting, the Public Relations Committee also approved the preparation of four additional releases to be prepared during the year ending in May, 1958. These include the fifteenth Alloys of Iron monograph, the work of the Corrosion Research Council, and descriptions of The Foundation's projects on comminution and on wood poles.

ASME representatives on the Board of the Engineering Foundation are E. L. Robinson and R. C. Allen. H. E. Martin is a Trustee representative and E. M. Barber is member at large.

1958 Nuclear Congress Plans Announced

International Amphitheater and the Palmer House, Chicago, Headquarters for Congress, March 17–21

THE atomic energy industry of the United States will demonstrate its progress in the uses of nuclear energy for the benefit of the Western World during the 1958 Nuclear Congress, March 17–21, 1958, at the International Amphitheater, Chicago, Ill.

Further declassification of information will make it possible for the 1958 Nuclear Congress to make available additional material to give further meaning to the conclave's slogan, "Industrializing the Atom."

More than 30 sponsoring organizations, including The American Society of Mechanical Engineers, will bring together leaders in science, engineering, industry, government education, health, and agriculture in this nuclear assembly, which will include the Fourth Nuclear Engineering and Science Conference; the atomic exposition, "Atomfair"; the sixth Hot Laboratories and Equipment Conference; the Atomic Energy Management Conference; and the American Power Conference.

Co-ordinating agency for the Nuclear Congress is Engineers Joint Council, while the management is under the direction of the American Institute of Chemical Engineers.

Bruce R. Prentice, Mem. ASME, of the General Electric Company, is general chairman of the 1958 Nuclear Congress and John W. Landis of The Babcock & Wilcox Company and the American Nuclear Society is program chairman of the Nuclear Engineering and Science Conference. John R. Dunning, Mem. ASME, dean of engineering, Columbia University, is chairman of the Nuclear Congress Policy Board.

Four Elements Make Congress

The four major elements of the 1958 Congress and the area each covers are:

1 The Nuclear Engineering and Sci-

ence Conference, on behalf of more than 30 participating engineering and scientific societies, will present 150 technical papers on late developments in the several fields of atomic energy applications, including a number of papers on aircraft propulsion. Requests for preprints of papers should be addressed to American Institute of Chemical Engineers, 25 West 45th Street, New York 36, N. Y. All papers sell for 50 cents each. ASME papers coupons do not apply toward the purchase of Congress papers.

2 The Atomic Industrial Forum, Inc., Atomfair will be held in conjunction with the technical sessions of the Congress and will feature the latest developments in industrial uses of atomic energy.

3 Atomic Energy Management Conference, sponsored jointly by the National Industrial Conference Board and the Atomic Industrial Forum, Inc., which will provide management with a comprehensive review of progress made to develop low-cost nuclear power and other industrial uses of atomic energy. Representatives from industry, science, and management from many countries will discuss the impact of the atom on our economy.

4 The Sixth Hot Laboratories and Equipment Conference, sponsored by the Hot Laboratories Committee of the Oak Ridge National Laboratories, will deal with the highly technical details of the development of equipment and the operation of laboratories for atomic energy.

The American Power Conference is also participating in the Congress. Thus the representatives from many countries to this meeting will be enabled to participate in the aspects of power generation covered by the Congress.

Attendance at the 1958 Congress is expected to exceed that of the 1957 Congress in Philadelphia, Pa., when 16,000 participated, including 3000 at the technical meetings.

The Atomfair and the conferences are to be held at the International Amphitheater, while headquarters hotel will be the Palmer House.

Technical Papers

The following general categories will be covered in the technical meetings: Commercial use of radioactive tracers; reactor component development, fabrication and testing; standardization, codes, and licensing; reactors for process heat and radiation; production and miscellaneous applications of radioisotopes; reactor operation and maintenance; fuel, control, moderator, and coolant materials; experimental power reactors and advanced concepts; health physics and instrumentation; reactor physics; temperature measurement and high-temperature instrumentation; waste treatment and disposal; reactor plant instrumentation; reactor location and safety; thermal and mechanical design; reactor control instrumentation; progress in commercial power reactor development; reactor plant materials; fuel element development, fabrication, and testing; reactor safety and start-up instrumentation; reactor systems analysis; research and test reactors and critical assemblies: chemical reprocessing; water contamination and treatment; and reactor shielding and containment.

IMECHE MEETINGS

March 25–27

Conference on the Technology of Engineering Manufacture, IMechE, London. (After March 27 a complete set of conference papers will be available at £ 3 3*s*. 0*d*.)

1958 Summer Meeting

IMechE Summer Meeting will probably take place in mid-June and will be centered in Cardiff and district, in the area of the South Wales Branch.

▶ *Note:* The foregoing calendar of The Institution of Mechanical Engineers (Great Britain) meetings is published as a service to members of ASME. Further information relating to complete programs and available papers may be obtained from The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London, S.W.1, England. Preliminary programs also are published in *The Chartered Mechanical Engineer* (IMechE) which is on file in the Engineering Societies Library, 29 West 39th Street, New York 18, N. Y., and other libraries throughout the United States and Canada.

Plans for Power Conference to Feature Nuclear Progress Report

A PROGRESS report on nuclear developments in the electric power industry will be among featured discussions at the twentieth annual American Power Conference to be held at the Hotel Sherman, Chicago, Ill., on March 26-28.

Executives of a number of electric-utility companies, at a forum on March 26, will describe the current status of the various nuclear reactor projects in which their companies are participating, and discuss plans for future research and development.

The American Power Conference, which is held in Chicago each year, is sponsored by Illinois Institute of Technology in co-operation with 14 other colleges and universities and nine engineering societies, of which The American Society of Mechanical Engineers is one.

Technical Program

The nuclear power forum will be one of 30 sessions scheduled during the three-day meeting, which also will include a technical session on nuclear power generation.

The program will include approximately 90 papers covering a wide variety of aspects in the electric-power industry and related activities. They will include addresses at luncheon meetings on each of the three days and at the All Engineers dinner on March 27.

New and exotic propellants, such as fluorine, boron compounds, and hydrazine, economics of fuel transportation, experiences in the operation of the first commercial supercritical pressure steam-electric generating station, and high-voltage transmission will be among subjects to be covered. The latter will be discussed by a group of foreign scientists whose countries have had great experience in this field.

In addition, one or more sessions will be devoted to discussions of the generation, transmission, and utilization of electric energy, use of pumped storage for hydroelectric stations, steam and gas turbines, industrial power plants, steam generators, and heating and air conditioning.

Co-operating Schools and Societies

The colleges and universities co-operating in the conference are: Illinois, Iowa, Iowa State, Michigan, Michigan State, Northwestern, Purdue, Minnesota, Wisconsin, Texas A&M, New York, California Institute of Technology, Georgia Institute of Technology, and Massachusetts Institute of Technology.

The co-operating societies are American Institute of Chemical Engineers, American Institute of Electrical Engineers, American Institute of Mining, Metallurgical, and Petroleum Engineers, American Society of Civil Engineers, American Society of Heating and Air-Conditioning Engineers, The American Society of Mechanical Engineers, National Association of Power Engineers, Western Society of Engineers, and Engineers' Society of Milwaukee.

1959 International Congress of Combustion Engineers to Be Held in Germany

Plans announced for fifth biennial meeting

THE fifth biennial meeting of the International Congress of Combustion Engineers (CIMAC) will be held in Germany, in May or June, 1959.

The theme of the Congress will be: Diesel engines and gas turbines up to 1500 bhp. Current problems concerning design, production, development, and running at site.

The U. S. National Committee is sponsored by the Oil and Gas Power Division and Gas Turbine Power Division of The American Society of Mechanical Engineers. The U. S. National Committee personnel includes: Chairman, John C. Gibb, Socony-Mobil Oil Company, New York, N. Y.; vice-chairman, R. Tom Sawyer, Hohokus, N. J.; and secretary-treasurer, Robert L. Stanley, Diesel Engine Manufacturers Association, 2000 K Street, N. W., Washington, D. C.

The U. S. National Committee of CIMAC invites prospective authors to submit to them information on proposed papers giving the following particulars as required by the Permanent (International) CIMAC Committee:

1 Name, company, position, and references regarding the chosen subject.

2 The title of the proposed paper accompanied not only by a simple résumé, but also by a plan or analytical report not exceeding two typed pages, complete with list of probable figures, graphs, and tables to be attached, which will permit an opinion to be formed of the interest it is likely to arouse within the framework of the chosen field.

Anyone desiring to present a paper, either in his own name or in the name of his company, must submit the aforementioned information to the U. S. National Committee on or before Feb. 15, 1958.

Authors of papers finally accepted by CIMAC will be so advised in March, 1958, and at the same time will be given the necessary instructions for preparing their final papers.

The Permanent Committee of CIMAC points out the following:

1 All papers of an advertising, commercial, or purely descriptive nature will be systematically excluded.

2 Papers will be accepted only if they contain new matter on one of the following subjects:

(*a*) New fields of application for diesel engines or gas turbines provided these have been carried out in practice.

(*b*) Theoretical studies or tests on cycles of working, scavenging, supercharging, injection, combustion, heat-exchanging, or heat recovery and means of carrying them out.

(*c*) Investigations or tests on the shape, dimensions, and design of engine and turbine components.

(*d*) Study of breakdowns: scientific explanations and remedies.

(*e*) Methods of test or test results of a definitely novel character.

(*f*) Results arising from running at site, technical or financial, supported by actual cases.

Authors are urged to submit the outline of their papers through the secretary of the U. S. National Committee.

AMA Report Reveals . . .

American and Canadian Executives Salaries Up Again in 1957

AMERICAN and Canadian companies increased the compensation paid to their top executives by an average of 5.1 per cent last year, according to the eighth annual survey of top management compensation distributed in December, 1957, by the Executive Compensation Service of the American Management Association. This compares with a 5.9 per cent increase recorded for the previous year.

These are over-all averages and do not reflect the variations in individual companies and industries that result from a variety of forces, Dean H. Rosensteel, director of the service, emphasized. The size of the company, the complexity of its operations, and its sales and profits are important factors.

The new study, the most comprehensive top management survey ever conducted, analyzes the total compensation paid to some 35,000 high-ranking executives in more than 3800 companies of all sizes and types in the United States and Canada. The time period covered was essentially the calendar year of 1956, but fiscal years that closed as late as July, 1957, were included.

For the first time a special section on small companies (those with annual sales of less than $1 million to $10 million) was added to the AMA report. The small company analysis, based on a study of 716 firms, shows that top management compensation in the smaller companies varies in direct relation to size and to product and market served, much as it varies by industry classification and size in the larger ones.

However, the amounts paid to individuals in smaller companies also vary with the number of positions at the top management level. Every company has a chief executive officer, but the needs of individual organizations for other positions vary. When the business grows larger than can be supervised by one man, the next position added in 60 to more than 80 per cent of the cases is someone to supervise manufacturing operations. Generally, in small companies, as the number of officers increases, the average compensation to each officer decreases. When a man is responsible for a combination of functions, he is paid more than one responsible for only one function.

Economic conditions have a strong influence on top executive compensation, but the correlation is only partial. In 1956 the companies surveyed increased their sales by 7.8 per cent, on the average; showed a 5 per cent gain in net profits; and paid their top managements 5.1 per cent more. In 1956, sales increased an average of 10 per cent; profits were nearly 25 per cent higher than the previous year; but top executive compensation increased only 5.9 per cent.

The AMA Executive Compensation Service, of which the annual top management survey is the principal project, was established to help management determine fair and equitable pay for executive personnel by methods that will provide effective incentives. The service also conducts continuing surveys of the compensation of middle management personnel, administrative and technical positions, sales personnel, and first-line supervisors, and issues periodic reports on methods of compensating executives.

Additional information about the service may be obtained from AMA headquarters in New York, N. Y.

E. R. Needles Scores Technological Program Misdirection as U. S. Threat

"The United States is challenged now as a world power because of misdirection of its technological program, not because of the lack of present technological capability."

Enoch R. Needles, prominent consulting engineer, made this statement at his installation on Jan. 10, 1958, as president of Engineers Joint Council, the unity organization of the engineering profession. When he took office at the Board of Directors meeting, Mr. Needles made four points, summing up the present situation as it relates to engineering and science.

"The situation in which we find ourselves," said Mr. Needles, "is not the result of technological failure. It is rather the result of mistaken decisions in program emphasis and manpower administration during the past decade. To ascribe the Russian rocket and satellite lead to weakness in American technology is misleading and erroneous. There is no evidence to indicate that the 'race' is temporarily lost for technological reasons.

"There is no question but that any one of several engineering and scientific organizations could have won the race to get an earth's satellite into the air if this had been considered of prime political significance, and if this was to have been used as the basic measure of our technological excellence. We have not lost our technological leadership or engineering productivity, but we must push everlastingly forward in our educational processes for engineers and scientists, and the orderly and intelligent administration of their endeavors and services."

Supplementing these thoughts, in his second point, Mr. Needles emphasized that "educational reform can have absolutely no effect on our technological performance during the crucial next three years when our technical accomplishments must be truly in keeping with our great capabilities, to restore the temporarily dimmed prestige of the U.S. The first step the country must take is to provide adequate administration and direction for the technological team of scientists and engineers which exists.

"Guns or butter," continued the president of EJC, "is a cliché inconsistent with the technological capacity of this country. From the point of view of our engineering and scientific capacity, there is no reason why the United States cannot have, at one and the same time, a continuing rise in the living standard and a defense capacity of ever-increasing strength."

In his fourth point, Mr. Needles stressed the need for caution in long-range fundamental educational programs. "Educational re-emphasis," he concluded, "which can have only long-range effects should be concerned primarily with the quality of that education rather than the quantity."

To underscore the authority of his estimate of the current crisis in engineering and science, Mr. Needles pointed out that in January, 1955, Engineers Joint Council, together with the Columbia School of Engineering, warned the nation of the new perilous position of this country in a press conference entitled, "The Cold War for Engineering Manpower" in which, for the first time, the United States' lag in manpower and misuse of its technological team were made clear to the American public.

"The role of Engineers Joint Council, the organization through which the engineering profession can make itself heard," concluded Mr. Needles, "is more vital than ever. And in this instance it is saying most emphatically that the technical force of the United States is capable of meeting any challenge to world supremacy providing it is given the responsibility and administration it needs."

E. R. Needles defends U. S. technological capability at installation as EJC president, Jan. 10, 1958

EJC is a federation of 17 major national and regional engineering societies, of which The American Society of Mechanical Engineers is one, representing more than 250,000 of the nation's engineers.

Fifth World Petroleum Congress Announces Preliminary Plans

Meetings in New York Coliseum June, 1959, offer wide program

The latest developments in oil research, production, refining, and distributive processes will be demonstrated in an exposition at New York's Coliseum being staged during the Fifth World Petroleum Congress in June, 1959. Exhibits will illustrate scientific advances which will be discussed at the various sessions of the six-day Congress, the first World Congress to be held in the United States.

Exhibits. Present plans call for exhibits by manufacturers of equipment and materials used in drilling, refining, and other primary productive processes, makers of equipment and instruments employed in research, analysis, testing and measurements, and agencies engaged in the transportation of petroleum products. There is to be a symposium during the Congress on the utilization of nuclear energy in the oil industry and the exposition will include exhibits in this field of research.

Technical Program. The Congress will be all-embracing in scope. There will be 70 or 80 technical sessions which will be divided into the following nine sections: Geology and geophysics; drilling and production; oil processes and refining; chemicals from petroleum and natural gas; composition, analysis, and testing; utilization of petroleum products; engineering, equipment, and materials; transportation, distribution, marketing; and operations research, statistics, and education. It is expected that about 200 papers will be delivered by authors from all over the world with ensuing discussion from the floor.

The Congress will be held at a time

when attention will be more than ordinarily centered upon petroleum progress through events celebrating the American Petroleum Centennial marking the anniversary of the first commercial oil strike made by Colonel Drake at Titusville, Pa., in 1859.

The four previous world congresses were held in London (1933), Paris (1937), The Hague (1951), and Rome (1955). Continuity in planning the congresses has been maintained through an international Permanent Council which since 1955 had included representatives from Austria, Belgium, Canada, France, Germany, Great Britain, Holland, Italy, Mexico, the United States, and Venezuela.

PEOPLE

Honors and Awards. SCOTT TURNER, of New York, former director of the United States Bureau of Mines, has been chosen by the representatives of ASME, ASCE, AIME, and AIEE to receive their jointly-sponsored Hoover Medal for 1957.

Named after former President Herbert Hoover, who was its first recipient, in 1930, this gold medal is awarded "by engineers, to a fellow-engineer, for distinguished public service."

JOHN F. THOMPSON, chairman of the board, The International Nickel Company of Canada, Ltd., has been named the recipient of the Charles F. Rand Memorial Medal for 1958. The award is presented by the American Institute of Mining, Metallurgical, and Petroleum Engineers.

The citation states that the award to Dr. Thompson is "for his leadership of a mining and metallurgical enterprise which has contributed to free world strength; for administrative skills which have furthered the progress of the nickel industry; for his vision in stimulating scientific research; for demonstrating the value of a technical education combined with broad interests and human understanding."

J. ROY GORDON, of New York, executive vice-president of The International Nickel Company of Canada, Ltd., and The International Nickel Company, Inc., is the recipient of the AIME James Douglas Gold Medal.

The award is "for distinguished contributions to process metallurgy in the field of smelting and refining of nickel, and metallurgical improvements in nickel recovery."

ARTHUR EMMONS RAYMOND, vice-president and director, Douglas Aircraft Company, Inc., Santa Monica, Calif., has been awarded the Daniel Guggenheim Medal for 1957.

The award was presented for his "development of a long line of successful civil and military aircraft and for notable contributions to aeronautics in public service."

JOHN ROBERT SUMAN, petroleum consultant, Houston, Texas, has been awarded the John Fritz Medal for 1958. He was cited as a pioneer in the application of engineering principles to the development, production, and conservation of petroleum and natural gas; author; industrial statesman; and one who takes a keen interest and real pleasure in inspiring men to make the most of their talents.

J. P. DEN HARTOG, Fellow ASME, and professor of mechanical engineering, M.I.T., delivered the forty-fourth Thomas Hawksley Lecture at a General Meeting held at the Institution of Mechanical Engineers, London, England, on November 15. The lecture was entitled, "Vibration: A Survey of Industrial Application."

SIR FRANK WHITTLE, British inventor of the turbojet engine, has received the 1957 John Scott Medal. EMIL A. KEKICH, commercial attaché at the United States Embassy in London, presented the medal, a scroll, and $1000, on behalf of the City Trusts of Philadelphia, trustees of the John Scott Legacy.

ROGER E. GAY, a former president and chairman of the board of The Bristol Brass Corporation, Bristol, Conn., was awarded ASA's Howard Coonley Medal for "great service in advancing the national economy through voluntary standards."

JOHN ROBERT TOWNSEND, special assistant to the Assistant Secretary of Defense, Research and Engineering, received ASA's Standards Medal. This medal is awarded for leadership in the actual development and application of standards. The medals were presented during the eighth National Conference on Standards held in San Francisco, Calif., November 13–15.

VANNEVAR BUSH, Hon. ASME, chairman of the Corporation of Massachusetts Institute of Technology, received "The New England Award" of the Engineering Societies of New England. The award is given annually to a New England engineer who "merits recognition of his accomplished work as well as of his character." Dr. Bush has been a leading figure in the development of nuclear fission and served as wartime director of the Office of Scientific Research and Development.

VINCENT S. LAZZARA, president, Casting Engineers, Chicago, Ill., received the "whale" award of the Investment Casting Institute for his "devotion to the Institute since its inception." Lazzara, who has served as treasurer, vice-president, and president of the group, conceived the idea of the "whale" award several years ago. Also honored was RICHARD A. FLINN, University of Michigan, for his liaison work between the Institute and the universities in the dissemination of educational information on the investment casting process. The award symbolizes a "whale of a job" done by the recipients.

ERNEST O. LAWRENCE, Nobel Prize winner, physicist, and director of the University of California Radiation Laboratory at Berkeley, Calif., has been named to receive the 1957 Atomic Energy Commission's Enrico Fermi Award.

The Award, consisting of a medal, a citation, and $50,000, was made to Dr. Lawrence for his invention and development of the cyclotron and his other contributions to the development of atomic energy and nuclear physics. It was made on the recommendation of the General Advisory Committee of the Atomic Energy Commission and approved by President Eisenhower.

The presentation was made on the fifteenth anniversary of the day when the late Dr. Enrico Fermi, after whom the award was named, and his associates proved that nuclear fission could be self-sustained and controlled. This discovery led to the development of the first atom bomb.

JOHN K. HODNETTE, vice-president, general manager, and a director of the Westinghouse Electric Corporation, is the recipient of the 1957 Edison Medal awarded by the American Institute of Electrical Engineers. Mr. Hodnette was cited for his contributions to the electrical industry through "creative design and development of transformer apparatus which marked new advances in protection, performance, and service."

NIELS BOHR, Danish physicist and Nobel Prize winner, has received the New York University Medal. Dr. Bohr, director of the Institute for Theoretical Physics at the University of Copenhagen, in Denmark, received the medal for his many great contributions to science.

ALEXANDER SILVERMAN, professor emeritus of chemistry, University of

Pittsburgh, has been chosen to receive the 1958 Albert Victor Bleininger Award. The award, one of the highest honors for achievement in ceramics, has been given each year since 1948 by the Pittsburgh Section of the American Ceramic Society.

WILLIAM J. KROLL is the recipient of the Perkin Medal presented annually by the American Section of the Society of Chemical Industry.

GEORGE SACHS, Mem. ASME, professor of metallurgical engineering and associate director, Syracuse University Research Institute, will receive an honorary DE degree at the May 5, 1958, commencement of the Bergakademie (School of Mines), Clausthal, West Germany.

JOHN W. BOLTON, former director of metallurgical research and testing, Lunkenheimer Company, Cincinnati, Ohio, has received the American Society for Testing Materials Award of Merit. The award is for distinguished service to the society.

Campus Data. RICHARD GILMAN FOLSOM, Mem. ASME, has been elected president of Rensselaer Polytechnic Institute by the Institute's board of trustees. Dr. Folsom has been professor of mechanical engineering and director of the Engineering Research Institute of the University of Michigan. He will succeed LIVINGSTON WADDELL HOUSTON, Mem. ASME, on March 1, 1958. Dr. Houston resigned after 14 years of service to the Institute.

NICHOLAS HOFF, Mem. ASME, has joined the faculty of Stanford University as executive head of the division of aeronautical engineering. He had been head of the aeronautical engineering department of the Polytechnic Institute of Brooklyn. His successor at BPI is ANTONIO FERRI, pioneer in supersonic aerodynamics.

LEO J. LASSALLE, Mem. ASME, has been named dean-emeritus of Louisiana State University, college of engineering. Dr. Lassalle retired July 1, 1957. FRED H. FENN is his successor.

Research. SIGVARD A. EKLUND, director of research for the Swedish Atomic Energy Company, Stockholm, has been named secretary-general of the conference. Recently he arrived in New York to take up his duties as conference secretary-general in which capacity he will serve as an officer of the United Nations Secretariat as well.

MARTIN GOLAND, Mem. ASME, and editor of *Applied Mechanics Reviews*, will serve as Director of Southwest Research Institute in addition to his duties as Institute vice-president. HAROLD VAGTBORG, Mem. ASME, will continue as president of Southwest Research Center which now includes the newly formed Southwest Agricultural Institute, in addition to the Southwest Research Institute and Southwest Foundation for Research and Education.

New Officers. ELMER R. QUEER, director and professor of engineering research, The Pennsylvania State University, University Park, Pa., has been nominated for the presidency of the American Society of Heating and Air-Conditioning Engineers, it has been announced by the society president, PETER B. GORDON, New York, N. Y.

FRED L. PLUMMER, Mem. ASME, Warren, Pa., has been appointed national secretary of the American Welding Society. He will assume his new duties immediately and will maintain his office at the Society's National Headquarters in New York, N. Y. The appointment was made to fill the vacancy created by the resignation of JOSEPH G. MAGRATH who served as secretary for many years.

JOHN CAMERON FOX has been appointed secretary of the Society of Mining Engineers of AIME. Mr. Fox succeeds ARNOLD BUZZALINI, who has resigned to act as a geology consultant.

GARNET T. PAGE has been appointed as an assistant general secretary of The Engineering Institute of Canada. He was formerly general manager and secretary, and manager of publications, of the Chemical Institute of Canada.

STANLEY D. MICHAELSON, Salt Lake City, Utah, chief engineer, Western Mining Division, Kennecott Copper Corporation, has been nominated for 1958 AIME president.

EDWARD C. WELLS, vice-president—engineering, Boeing Airplane Company, has been elected president of IAS for 1958.

COMING MEETINGS

Flight-Control Symposium

"FLIGHT Control-Panel Integration" is the subject of an industry and service-wide symposium to be conducted in the Biltmore Hotel, Dayton, Ohio, February 3–4. The U. S. Air Force, Flight Control Laboratory, Wright Air Development Center is sponsoring the symposium with the assistance of the Cook Research Laboratories, Morton Grove, Ill.

For additional information and for reservations, write: John H. Kearns, Box 942, Dayton, Ohio.

Military-Industrial Conference

COMMERCE and industry's role in America's national strategy will be thoroughly explored during the three days of the Fourth National Military-Industrial Conference at the Conrad Hilton Hotel, Chicago, Ill., February 17–19.

Many of the country's foremost "thought leaders" and contributors to national policy decisions will be in the group of approximately 1200 spokesmen for commerce, industry, government, scientific and professional fields, higher education, and the armed services. The forum this year will focus attention on the nature and purpose of national strategy, particularly, in the light of current and foreseeable developments, and a fuller understanding of the interrelationship between civilian and military enterprise.

LITERATURE

Alloying Metals

"BORON, Calcium, Columbium, and Zirconium in Iron and Steel" is the fifteenth monograph brought out by Alloys of Iron Research and the fourth in a special series that has been in preparation since 1946 to cover the phenomenal advances in metallurgy made during the war.

With publication of this volume, Alloys of Iron Research provides a valuable source of reference for engineers, metallurgists, and others concerned with the effects of certain alloying metals on carbon steel and on both simple and complex alloy steels and cast iron. The 533-page work, consisting of a correlated summary of all the important literature on the use of boron, calcium, columbium, and zirconium as alloying metals, will be indispensable to the designer of metals to be used at very high temperatures and under high pressures. These alloying elements have made important contributions to such modern developments as atomic reactors, guided missiles, and jet engines.

Authors of the fourth monograph bring to the work a rich background of

experience in the metallurgical field. They are: R. A. Grange, U. S. Steel Corporation; F. J. Shortsleeve, D. C. Hilty, W. O. Binder, and C. M. Offenhauer, Electro Metallurgical Company; and G. T. Motock, of the Olin Mathieson Chemical Corporation. The volume has been carefully reviewed by authorities in the field and approved for publication by the Iron Alloys Committee.

John Wiley and Sons has published the Fourth Monograph for The Engineering Foundation. Copies are available at $14 from the publisher at 440 Fourth Avenue, New York 16, N. Y.

New Journal

THE American Institute of Physics will publish a new journal, *The Physics of Fluids*, starting with January, 1958.

The new journal will be devoted to original contributions to the physics of fluids covering kinetic theory, statistical mechanics, structure and general physics of gases, liquids and other fluids, as well as certain basic aspects of physics of fluids bordering geophysics, astrophysics, biophysics, and other fields of science. The scope of these fields of physics includes: magneto-fluid dynamics, ionized fluid and plasma physics, shock and detonation wave phenomena, hypersonic physics, rarefied gases and upper atmosphere phenomena, physical aeronomy, transport phenomena, hydrodynamics, dynamics of compressible fluids, boundary layer and turbulence phenomena, liquid state physics, and superfluidity.

The Board of Editors of the new journal consists of: J. W. Beams, University of Virginia; W. Bleakney, Princeton University; J. M. Burgers, University of Maryland; S. Chandrasekhar, Yerkes Observatory; H. L. Dryden, National Advisory Committee for Aeronautics; W. M. Elsasser, Scripps Institution of Oceanography; R. J. Emrich, Lehigh University; J. C. Evvard, Lewis Flight Propulsion Laboratory; J. O. Hirschfelder, University of Wisconsin; J. Kaplan, University of California, Los Angeles; J. G. Kirkwood, Yale University; G. Kuerti, Case Institute of Technology; A. M. Kuethe, University of Michigan; M. S. Plesset, California Institute of Technology; S. A. Schaaf, University of California, Berkeley; G. B. Schubauer, National Bureau of Standards; E. Teller, University of California, Berkeley; P. P. Wegener, Jet Propulsion Laboratory; and F. N. Frenkiel, Editor, Applied Physics Laboratory, The Johns Hopkins University.

The new journal will consider for publication original papers containing sufficiently significant results not published in any other recognized publication. *The Physics of Fluids* will start as a bimonthly and will become a monthly as soon as it appears desirable.

Correspondence on editorial matters should be addressed to: F. N. Frenkiel, editor, *The Physics of Fluids*, Applied Physics Laboratory, The Johns Hopkins University, Silver Spring, Md.

Subscription information can be obtained from the American Institute of Physics, 335 East 45th St., New York 17, N. Y.

INDUSTRIAL FILMS

Rocket Development

"MAN in Space," a 16-mm film originally previewed on the "Disneyland" television show, is now offered in a convenient 35 min length. It authoritatively traces rocket development from ancient Chinese weapons to modern missiles. It predicts the establishing of man-made satellites and then provocatively depicts in detail how man will undertake his first trip to outer space and return.

The Disney creative staff has joined forces with the top scientific team of Wernher von Braun and Heinz Haber to present authentic factual information about this vital subject.

The film may be rented for $15 per day; write: Walt Disney Production, 16-mm Film Division, 2400 W. Alameda Avenue, Burbank, Calif.

Honeycomb Repair

A NEW technique of repairing aluminum honeycomb structure under field conditions is demonstrated in a 16-mm color film, now available to industry on a limited basis.

A six-inch puncture in the trailing edge of a wing is repaired by two men whose tools and materials are all carried in a single cart. The 4-hr operation is reduced to its essentials in the film which runs ten minutes. Removal of damaged material, application of adhesive in the void, bonding a patch over the hole, and checking the bond, are the steps shown. Cleanliness is stressed throughout. The method can be used for repairing damage of all sizes and shapes.

Produced by the Engineering Division, Martin, Baltimore, Md., the Honeycomb Repair Film may be obtained from the Presentations Section, The Martin Company, Baltimore, Md. Att: Ann Juliano, Mail No. J-376.

MEETINGS OF OTHER SOCIETIES

Feb. 3–4

Instrument Society of America, chemical and petroleum symposium, Hotel Du Pont, Wilmington, Del.

Feb. 10–12

American Management Association, annual marketing conference, Hotel Statler, New York, N. Y.

Feb. 10–14

American Society for Testing Materials, Committee Week, Hotel Statler, St. Louis, Mo.

Feb. 13–15

National Society of Professional Engineers, spring meeting, Michigan State University, East Lansing, Mich.

Feb. 17–19

American Management Association, midwinter personnel conference, Palmer House, Chicago, Ill.

Feb. 28–March 1

American Society for Quality Control, Middle Atlantic Conference, Hotel Statler, New York, N. Y.

March 3

Cleveland Engineering Society, annual machine design conference, Cleveland Engineering Society, Cleveland, Ohio

March 3–4

AIME Society of Petroleum Engineers, annual joint meeting, Cosmopolitan Hotel, Denver, Colo.

March 3–5

American Management Association, annual electronics conference, Hotel Statler, New York, N. Y.

March 6–7

Society of the Plastics Industry, Inc., annual Canadian section conference, Royal Connaught Hotel, Hamilton, Ont., Canada

(*For ASME Coming Events, see page 143*)

EDUCATION

Nuclear Engineering

RENSSELAER Polytechnic Institute has announced graduate courses of study in nuclear science and engineering leading to masters' and doctors' degrees. The courses are designed for scientists and

engineers who wish to prepare for advanced work in the nuclear power field or in related activities.

New Courses

● NORTHEASTERN University, Cambridge, Mass., has announced a day-evening study program, to be given at its Lincoln Institute, which could lead to a bachelor's degree in engineering—civil, mechanical, chemical, and industrial.

The program consists of a four-year evening study program designed to prepare students to transfer to the third year of the regular daytime curriculum in the Northeastern University College of Engineering.

Enrollment is limited to students who meet requirements for admission to the day program.

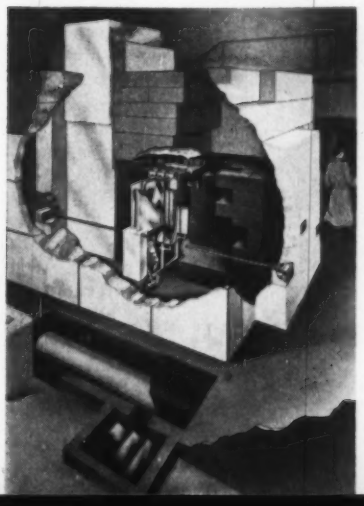
● THE trustees of Pratt Institute have approved a new curriculum in the school of engineering. The curriculum provides a basic plan of study for the first two years of study of all branches of engineering, except chemical engineering, which will deviate slightly. A curriculum in engineering science will also be established. Plans for enlarging the faculty are under way, and it is hoped that within the next ten years the master's degree program and the doctorate program will be significant graduate offerings.

Campus Development Programs

● A MECHANICAL engineering building, the largest of eight units in Cornell University's new engineering college group, has been given to the university by an alumnus, Maxwell M. Upson, Fellow ASME, chairman of the board of the Raymond Concrete Pile Company, New York, N. Y. The building accommodates approximately 700 undergraduate and graduate mechanical engineering students.

Research Sawmill Installation. Graduate students and members of the college staff at the College of Forestry, The State University of New York, will benefit from the research sawmill installation at the Hugh P. Baker Laboratory. Under the design direction of W. K. Stamets, Jr., Mem. ASME, The Enterprise Company, Columbiana, Ohio, has provided all sawmill, instrumentation, and drive equipment. The primary purpose of the special mill is a series of studies on optimum design for sawmill operation, controlled testing of saws, and recommended data on sawing species of timber from all parts of the world. Undergraduate forestry students will also have access to the equipment for instruction and study.

"Educator" training reactor to be designed and constructed by AMF Atomics Division of American Machine & Foundry Company and Dr. Walter H. Zinn's General Nuclear Engineering Corporation. An improved version of the Argonaut type design, the 10-kw reactor is inherently safe, making it readily adaptable for training purposes both in universities and industry.



● ESTABLISHMENT of the Harvard-Guggenheim Center for Aviation Health and Safety at Harvard University's School of Public Health in Boston, was announced by Nathan M. Pusey, president of the university, and Harry F. Guggenheim, president of the Daniel and Florence Guggenheim Foundation. The new center will study responses of the human body to extreme speeds, altitudes, temperatures, and toxic agents in flight and on the ground, and carry on basic research in the prevention and control of the increasing dangers of the air age.

The Harvard-Guggenheim Center will serve three basic purposes: To unify basic research into the sharply increasing human problems of the jet era; to give advanced training to physicians, biological scientists, and aeronautical engineers; and to serve as a clearinghouse for technical information on aviation health and safety. The work of such diverse specialists as engineers, physicians, psychologists, and anthropologists in solving problems will be co-ordinated.

● THE University of Michigan, Ann Arbor, Mich., dedicated two modern laboratories for research and instruction in automotive and aeronautical engineering on Oct. 15, 1957. The laboratories are located on the university's North Campus, which is already the site of a one-million-watt nuclear reactor, a laboratory for atomic energy research, and an engineering research building. A Fluids Engineering Laboratory is under construction, and other buildings of the College of Engineering and the Schools of Music and Architecture are to be added.

● PRINCETON University has announced completion of plans for a projected new engineering quadrangle. Plans for the new quadrangle include a library, seven times the size of the present area; more efficient shop facilities; a computational center providing the services of a modern digital computer and operating staff; and an instrument center; each for the use of all departments.

To provide maximum flexibility for future requirements, the buildings are modular in design. As demands change adjacent modules may be readily converted to larger or smaller forms.

Architectural treatment of the exterior will incorporate elements of traditional and contemporary design, which will blend with the traditional type buildings now prevalent on the campus.

Fellowships and Scholarships

● THE Board of Trustees of the Scholarship Fund of the Society of Women Engineers has announced the establishment of the Lillian Moller Gilbreth Scholarship in the amount of $500. The scholarship will be awarded for the first time for the academic year 1958-1959.

Notes on Society Activities and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

Meetings, Meetings, Meetings . . .

. . . ASME Schedules Longest List of Conferences in Its History

THE heaviest schedule of national meetings and conferences in its history was announced recently by The American Society of Mechanical Engineers. The Society will sponsor or cosponsor 24 major events at locations throughout the country, during 1958, dealing with dozens of technical subjects. All ASME meetings are open to interested persons, whether members of the Society or not.

In addition to its own meetings, ASME will take part in the 1958 Nuclear Congress to be co-ordinated by Engineers Joint Council in Chicago, Ill., March 16–22, and in the Third U. S. Congress of Theoretical and Applied Mechanics, June 11–14, at Providence, R. I.

The announcement noted a trend toward increased emphasis on conferences dealing with a particular field of engineering "as a result of the increased complexity of subject matter in virtually all fields of engineering."

"This increase," it was said, "has made it desirable to devote more time and effort to covering advances in each field than is possible at 'general' meetings where each of the 23 Professional Divisions of the Society present programs during a period of four or five days."

Typical of the trend toward specialized meetings are four new conferences to be sponsored by units of the Society during 1958 including one in Pittsburgh, Pa., April 14–15, under the newly formed Maintenance and Plant Engineering group of ASME. Other conferences that will be held for the first time this year are: Production Engineering, Worcester, Mass., April 10; Materials Handling, Cleveland, Ohio, June 9–12; and Process Industries, Buffalo, N. Y., September 15–17.

Beginning March 17, the Society will join the American Rocket Society in a four-day ASME-ARS Joint Aviation Conference to be held in Dallas, Texas. During September, the International Conference on Air Pollution, second event of its kind, will be held in New York under sponsorship of the ASME Air Pollution Controls Committee.

In the January, 1958, issue of MECHANICAL ENGINEERING, the Gas Turbine Power Conference and the Engineering Management Conference programs appear. This issue carries conference programs for Aviation, Plant Maintenance and Engineering, Wood Industries, Textiles, and Instruments and Regulators.

Take your choice—no one could attend all the meetings and keep abreast of his work; but attend the meetings covering a specific interest and see if it does not help "smooth out the wrinkles."

Chance Vought Aircraft Dallas plant is listed for inspection during ASME-ARS Aviation Conference, March 16–20. Regulus I guided missile is a CV product.

Several societies join to tell Aviation's story . . .

ASME-ARS Joint Aviation Conference in Dallas Will Cover a Variety of Topics

AVIATION authorities from all over the country will assemble for the ASME-ARS Aviation Conference to be held in the Statler-Hilton Hotel, Dallas, Texas, March 16-20, 1958, to discuss current problems existing in the field of aviation, solutions to past questions, and to see how the future shapes up.

The conference is sponsored jointly by the Aviation Division of The American Society of Mechanical Engineers and the American Rocket Society, an affiliate of ASME, in co-operation with the ASME Instruments and Regulators, Heat Transfer, Lubrication, and Management Divisions, the North Texas Sections of ASME, ARS, the Institute of the Aeronautical Sciences, and the Human Factors Society of America.

During the four-day program the conferees will have the opportunity of hearing first-hand information on air transport, solid rockets, thermal flight, missiles, and the human factors pertaining to this work. In addition, three inspection trips are scheduled.

The social program has not been neglected. Three luncheons are announced in the advance bulletin featuring top-notch speakers, and the Aviation Banquet on Tuesday evening is planned to be the high light of the meeting. A program of events for the women who plan to accompany the conferees is presently under way.

The tentative program follows:

▶ SUNDAY, MARCH 16

Registration — **3:00 p.m.**

▶ MONDAY, MARCH 17

Air Transport—Session 1 — 9:30 a.m.

Local Airlines and Equipment

Chairman: *Gwin Hicks*, president, Lake Central Airlines, Indianapolis, Ind.

Vice-Chairman: *Jim Graham*, vice-president, United States Aviation Underwriters, Inc.

Criteria for Local Airline Equipment,[1] by *B. J. Herkimer*, Aviation Financial Services

Airframe Design for Local Airlines,[1] by *W. H. Arata, Jr.*, Fairchild Aircraft Division, Hagerstown, Md.

Introduction of New Transport Designs and Their Effect on Traffic Potential for Local Service Airlines,[1] by *W. J. Mitchell*, Bonanza Air Lines, Inc., Las Vegas, Nev.

Aircraft Mechanisms—Session 1 — 9:30 a.m.

High-Speed Flight Challenges the Mechanical Engineer

Chairman: *Raymond C. Blaylock*, vice-president, engineering, Chance Vought Aircraft, Inc., Dallas, Texas

Mechanical Design in Aircraft, by *H. E. Cornish*, Douglas Aircraft Co., Inc., El Segundo, Calif. (Paper No. 58—AV-1)

Mechanical-Engineering Aspects of the High-Speed Aircraft Escape-System Problem, by *C. W. Russell*, Republic Aviation Corp., Farmingdale, L. I., N. Y. (Paper No. 58—AV-7)

The Quest for Operational Integrity of New Aircraft Systems, by *J. de S. Coutinho*, Grumman Aircraft Engineering Corp., Bethpage, N. Y., and adjunct professor of aeronautical engineering, Polytechnic Institute of Brooklyn. (Paper No. 58—AV-3)

Solid Rockets — 9:30 a.m.

Chairman: *William Schaafsma*, director of engineering, Grand Central Rocket Co., Redlands, Calif.

[1] Paper not available—see box on this page.

Propellant Explosives Classification and the Effect on Field Handling of Missiles, by *W. F. Haile*, Thiokol Chemical Corp., Huntsville, Ala. (ARS Paper No. 576-58)

Comparison of Dual-Thrust Motors With Separate Booster and Sustainer Motors as Solid-Propellant Propulsive Systems for Guided Missiles, by *G. E. Miles*, Phillips Petroleum Co., McGregor, Texas (ARS Paper No. 577-58)

Stability of Rubber-Base, Ammonium Nitrate Propellants, by *M. H. Whitlock* and *J. A. Keller*, Phillips Petroleum Co., Bartlesville, Okla. (ARS Paper No. 578-58)

Solid Propellant Engine Selection Studies for Ballistic Missiles, by *J. L. Gallagher* and *T. E. Phillips*, Convair, Division of General Dynamics Corp., Fort Worth, Texas (ARS Paper No. 579-58)

Ordering ASME Papers by Mail

ASME papers can be identified by the number 58—AV-00. Only numbered ASME papers in this program are available in separate copy form until Jan. 1, 1959. Copies can be obtained by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 25 cents each to members of ASME and ARS, and 50 cents to nonmembers. Papers must be ordered by the paper numbers listed in this program, otherwise the order will be returned.

ARS Papers

ARS papers can be identified by 000-58. Copies can be obtained by writing directly to the American Rocket Society, Inc., 500 Fifth Avenue, New York 36, N. Y. Prices are 25 cents each to members of ARS and ASME and 50 cents to nonmembers.

Welcoming Luncheon **12:00 noon**

Presiding: *John M. Stevenson*, chairman, North Texas Section, ASME; Delhi-Taylor Oil Corp., Dallas, Texas

Introductions: *C. F. Born*, Conference chairman; Major General, USAF (Ret.), Texas Instruments, Inc., Dallas, Texas

Welcome: *The Honorable R. L. Thornton, Sr.*, Mayor of Dallas, Texas

Response: *Clifford H. Shumaker*, vice-president, Region VIII, ASME; Southern Methodist University, Dallas, Texas

Address: *James N. Landis*, President, ASME; vice-president, Bechtel Corp., San Francisco, Calif.

Air Transport—Session 2 **2:30 p.m.**

Local Airlines Operations and Maintenance

Chairman: *Laddie H. Hamilton*, president, Ozark Airlines, St. Louis, Mo.

Vice-Chairman: *M. L. Cunningham*, assistant regional administrator, Civil Aeronautics Administration, Forth Worth, Texas

Operations Planned for Introducing New Aircraft Into a Local Service Airline System,[1] by *T. H. Davis*, Piedmont Airlines, Winston-Salem, N. C.

The Allison 501-D13 Prop-Jet Engine and Its Place in the Air Transport Industry,[1] by *J. D. Beaumont*, Allison Div., Gen. Motors Corp.

Local Service Airlines and the Jet Overhaul Problem,[1] by *J. E. Lockart, Jr.*, and *Al Harting*, Southwest Airmotive Co., Love Field, Dallas, Texas

Aircraft Mechanisms—Session 2 **2:30 p.m.**

High-Speed Flight Challenges the Mechanical Engineer

Chairman: *John de S. Coutinho*, Group Leader, Analysis Group, Grumman Aircraft Engineering Corp., Bethpage, N. Y., and adjunct professor of aeronautical engineering, Polytechnic Institute of Brooklyn

Aviation's Golden Period, by *J. E. Forry*, McDonnell Aircraft Corp., St. Louis, Mo. (Paper No. 58—AV-5)

Flight-Control Linkages, by *R. L. Roemer*, Grumman Aircraft Engineering Corp., Bethpage, N. Y. (Paper No. 58—AV-4)

Variable Incidence Wing-Operating Mechanism, by *D. Morton Bland*, Chance Vought Aircraft, Inc., Dallas, Texas (Paper No. 58—AV-2)

Rocket Installations **2:30 p.m.**

Chairman: *R. F. Rose*, chief, Propulsion Development Section, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, Calif.

Vice-Chairman: *H. W. Graham*, propulsion project engineer, Chance Vought Aircraft, Inc., Dallas, Texas

How Lockheed Achieved High Performance With the All Solid X-17 Vehicle, by *James Marmor*, Lockheed Aircraft Corp., Sunnyvale, Calif. (ARS Paper No. 580-58)

Installation of Solid Rocket Engines, by *Gene Dolgonas*, Aerojet-General Corp., Sacramento, Calif. (ARS Paper No. 581-58)

Design of Flame Deflectors, by *R. S. Pickford*, Aerojet-General Corp., Azusa, Calif. (ARS Paper No. 582-58)

Application of Rocket Engine to American Aircraft, by *J. M. Cumming*, Rocketdyne, Canoga Park, Calif. (ARS Paper No. 583-58)

Cocktail Party

Engineers Club of Dallas **6:00 p.m.**

▶ TUESDAY, MARCH 18

Air Transport—Session 3 **9:30 a.m.**

Maintenance by the Major Airlines

Chairman: *J. M. Glod*, Director-Cargo Services, American Airlines, Inc., New York, N. Y.

Achieving Production-Line Maintenance,[1] by *Ed Smick*, American Airlines, Inc.

Engineering Aspect of Maintenance-Cost Reduction,[1] by *E. R. Horton*, Braniff International Airways

Maintenance,[1] by *Irving Kessler*, Air Force Operations Analysis Group

[1] Paper not available—see box on page 135.

The Thermal Thicket in the Laboratory—Session 1 **9:30 a.m.**

Hydraulics and Accessories

Designing and Testing for High-Temperature Hydraulics, by *F. L. Moncher*, Aero Hydraulics Division, and *L. D. Taylor*, Research and Development Department, Vickers, Inc., Detroit, Mich. (Paper No. 58—AV-6)

Monitoring of Hydraulic Fluids During High-Temperature Testing,[1] by *R. L. Leslie*, Vickers, Inc.

Simulation of High-Speed Flight Conditions and Design of Equipment for Low-Power Engine Component Tests,[1] by *R. L. Penrose*, Low-Power Laboratory, Aviation Gas-Turbine Division, Westinghouse Electric Corp., Kansas City, Mo.

Human Factors in Engineering—Session 1 **9:30 a.m.**

Chairman: *Owen Q. Niehaus*, Bell Helicopter Co, Vice-Chairman: *Donald M. Ross*, University of Pittsburgh, Pittsburgh, Pa.

Will the Pilot Become Obsolete?[1] by *A. C. Williams, Jr.*, Hughes Aircraft Co.

Why Quickening Works,[1] by *H. B. Birmingham* and *F. V. Taylor*, Naval Research Laboratory

Designing Controls for Human Use,[1] by *J. H. Ely*, Dunlap and Associates

Guided Missile Instrumentation Panel **9:30 a.m.**

Chairman: *Robert E. Luke*, Ramo-Wooldridge Corp., Los Angeles, Calif.

Computing and Calibrating Vibration-Power Spectra, by *G. M. Barr* and *John Sorrels*, Ramo-Wooldridge Corp., Los Angeles, Calif. (ARS Paper No. 584-58)

Cures for Which There Are No Diseases, by *M. L. Klein*, Cohu Electronics, San Diego, Calif. (ARS Paper No. 585-58)

Standardization—Pro and Con, by *M. A. Lowy*, Ramo-Wooldridge Corp., Los Angeles, Calif. (ARS Paper No. 586-58)

Television Applied to Instrumentation, by *J. P. Day*, Kin Tel, San Diego, Calif. (ARS Paper No. 587-58)

Luncheon **12:00 noon**

Toastmaster: *G. H. Craig*, chairman, North Texas Section, ARS; Convair, Fort Worth, Texas

Air Transport—Session 4 **2:30 p.m.**

Passenger Comfort—Civilian and Military

Chairman: *Wilber W. Reaser*, Chief Air-Conditioning Section, Douglas Aircraft Co., Inc.

Cabin Cooling for the Douglas Jet Transport,[1] by *R. N. Krueger*, Douglas Aircraft Co., Inc.

B-58 Air Conditioning[1]

The Thermal Thicket in the Laboratory—Session 2 **2:30 p.m.**

Bearings and Lubrication

Chairman: *George A. Hargrove*, General Electric Co., Cincinnati, Ohio

Fatigue-Life Tests With Diester Lubrication on Aircraft-Ball Bearings,[1] by *C. C. Moore*, General Electric Co., Cincinnati, Ohio

Ball Motions and Sliding Friction in Ball Bearings,[1] by *A. B. Jones, Jr.*, Fafnir Bearing Co., New Britain, Conn.

Dry Film Lubricant Studies,[1] by *L. M. Berry*

The Forward Look—Session 1 **2:30 p.m.**

High-Energy Aviation Fuels, Their Promises and Problems,[1] by *Bob Wells*, Gulf Oil Corp., Pittsburgh, Pa.

Lunar Colonization: Its Challenges **2:30 p.m.**

Moderator: *David G. Simons*, Air Force Missile Development Center, Holloman AFB, N. Mex.

Forum

Arnold Small, Convair, San Diego, Calif.

Irwin Cooper, The Rand Corp., Santa Monica, Calif.

Eugene Konecci, Douglas Aircraft Co., Inc., Santa Monica, Calif.

Franki L. Van Der Wal, Ramo-Wooldridge Corp., Los Angeles, Calif.

Julian Ward, School of Aviation Medicine, Randolph AFB, Texas

New Materials and Processes **2:30 p.m.**

Ceramic Coatings of Engines, by *Paul Huppert*, Gulton Industries, Inc., Metuchen, N. J. (ARS Paper No. 588-58)

Developments on Reinforced Plastics for Rockets and Missiles, by *D. V. Rosato*, Raybestos-Manhattan, Inc., Manheim, Pa. (ARS Paper No. 589-58)

Recent Advances in Plastic Materials for Rocket and Missile Constructions, by *George Epstein* and *R. J. Brown, Jr.*, Aerojet-General Corp., Azuza, Calif. (ARS Paper No. 590-58)

Social Hour **6:00 p.m.**

Banquet **7:00 p.m.**

Toastmaster: *J. E. Jonsson*, president, Dallas Chamber of Commerce, Dallas, Texas; president, Texas Instruments, Inc., Dallas, Texas

▶ WEDNESDAY, MARCH 19

The Thermal Thicket in the Laboratory—Session 3 **9:30 a.m.**

Elevated-Temperature-Test Facilities

Chairman: *Simon Ostrach*, NACA Lewis Flight Propulsion Laboratory, Cleveland, Ohio

Vice-Chairman: *J. R. Woolf*, dean, Arlington State College, Arlington, Texas

The Tendency Toward Special Purpose High-Temperature Facilities,[1] by *R. Smelt*, Lockheed Missile Systems Division, Palo Alto, Calif.

High-Temperature Radiation Properties of Solids,[1] by *P. E. Glaser* and *Henry Blau, Jr.*, Arthur D. Little, Inc., Cambridge, Mass.

The "Tailored-Interface" Hypersonic Shock Tunnel,[1] by *C. E. Wittliff, M. R. Wilson*, and *A. Hertzberg*, Cornell Aeronautical Laboratory, Inc., Buffalo, N. Y.

A Mach 4 Rocket-Powered Supersonic Tunnel Using Ammonia-Oxygen as the Working Fluid,[1] by *R. W. Graham*, Rocket Tunnel, NACA, Cleveland, Ohio

Data Acquisition and Processing—Session 1 **9:30 a.m.**

Chairman: *Martin Goland*, vice-president, Southwest Research Institute, San Antonio, Texas

Philosophy and Mechanization of an Air-Data Computer,[1] by *H. F. Colvin, III*, and *Jack Andresen*, Kollsman Instrument Co., Elmhurst, N. Y.

Servoed Pressure Transducers as Air-Data Inputs,[1] by *S. E. Westman*, Air Research Manufacturing Co., Los Angeles, Calif.

High-Speed Data Management Used to Accelerate Jet-Engine Development,[1] by *E. V. Mills*, Flight Propulsion Laboratory, General Electric Co., Cincinnati, Ohio

Drones **9:30 a.m.**

Chairman: *James F. Reagan*, Ramo-Wooldridge Corp., Los Angeles, Calif.

Vice-Chairman: *B. O. Robinson*, Temco Aircraft Corp., Dallas, Texas

Eight-Minute Duration Solid-Propellant Engine for XKDT-1 Target Drone, by *J. A. Crask*, Phillips Petroleum Co., McGregor, Texas (ARS Paper No. 596-58)

A Review of the Scoring Problem, by *C. R. Bonnell*, Beech Aircraft Corp., Wichita, Kan. (ARS Paper No. 597-58)

Combat Surveillance Systems, by *Kirby Lamar*, Army Electronic Proving Grounds, Ft. Huachuca, Ariz. (ARS Paper No. 598-58)

Advances in Rocket Propulsion Systems for Target Aircraft, by *Arthur Sherman*, Reaction Motors, Inc., Denville, N. J. (ARS Paper No. 599-58)

Radar and Infrared Simulation Techniques, by *Nevin Palley*, Temco Aircraft Corp., Dallas, Texas (ARS Paper No. 600-58)

The Role and Function of Target Systems in the Weapon System Concept, by *P. G. Blenkush* and *A. Fuil*, Radioplane Co., Van Nuys, Calif. (ARS Paper No. 601-58)

Nuclear Propulsion **9:30 a.m.**

Some Data and Comments Concerning the Working Fluid Nuclear Rocket, by *L. M. Bagnall*, Convair, Fort Worth, Texas (ARS Paper No. 592-58)

Luncheon **12:00 noon**

Toastmaster: *C. F. Born*, Major General, USAF (Ret.); Texas Instruments, Inc., Dallas, Texas

Speaker: *S. E. Anderson*, Lieutenant General, USAF, Commander, Air Research and Development Command

The Thermal Thicket in the Laboratory—Session 4 **2:30 p.m.**

Elevated Temperature Test Facilities

Chairman: *R. Smelt*, Lockheed Missile Systems Div., Sunnyvale, Calif.

High-Temperature Wind Tunnels,[1] by *G. M. Giannini*, Giannini Research Corp., Santa Ana, Calif.

Heat-Flux Measurements in the Discharge of Fluid Stabilized Arcs,[1] by *J. H. Bonin* and *W. P. Manos*, Chicago Midway Laboratories, The University of Chicago, Chicago, Ill.

Aerodynamic Studies Concerning Mass Ablation Caused by Severe Heating,[1] by *Y. A. Yoler*, General Electric Co., Philadelphia, Pa.

Data Acquisition and Processing—Session 2 **2:30 p.m.**

Chairman: *J. L. Altekruse*, Avionics and Electronics Division, Goodyear Aircraft Corp., Akron, Ohio

Total Temperature Measurements,[1] by *F. D. Werner*, Rosemount Engineering Co., Minneapolis, Minn.

Force-Balance-Pressure Measuring Sensors,[1] by *G. P. Knapp*, Servomechanisms, Inc., Westbury, N. Y.

On a Temperature-Systeming Device Used as Measuring and Cooling/Heating Apparatus,[1] by *P. H. Savet*, Research and Development, American Bosch Arma Corp., Garden City, N. Y.

Space Flight **2:30 p.m.**

Chairman: *A. Kalitinsky*, Convair, Fort Worth, Texas

Vice-Chairman: *C. L. Seacord*, Convair, Fort Worth, Texas

The Mechanics of Some Interspace Orbits, by *W. A. Orr*, Convair, Fort Worth, Texas (ARS Paper No. 603-58)

Optimum-Thrust Programming Along Arbitrarily Inclined Rectilinear Paths, by *Angelo Miele*, Purdue University (ARS Paper No. 604-58)

Flight Mechanics of Low-Thrust High-Energy Space Vehicles, by *F. Perebec*, Rocketdyne, Division of North American Aviation, Inc., Canoga Park, Calif. (ARS Paper No. 605-58)

Re-entry Structures, Thermal Stresses, and Limit Designs, by *D. N. Buell*, Chrysler Corp., Detroit, Mich. (ARS Paper No. 606-58)

Aerodynamic Propulsion **2:30 p.m.**

Chairman: *Weldon Worth*, consultant to chief, Power-Plant Laboratory, Wright ADC, Dayton, Ohio

Vice-Chairman: *W. C. Schoolfield*, assistant chief engineer, Missiles, Chance Vought Aircraft, Inc., Dallas, Texas

High-Speed Propulsion Schemes: An Analytical Comparison, by *Andrew Charwat*, University of California, Los Angeles (ARS Paper No. 602-58)

Invited spokesmen from both the propulsion and missile-design fields will present prepared discussions at conclusion of presentation.

▶ **THURSDAY, MARCH 20**

Field Trip **8:30 a.m.**

Phillips Petroleum Company, McGregor, Texas

Field Trip **9:00 a.m.**

Chance Vought Aircraft Company and CONVAIR, Fort Worth, Texas

Field Trip **9:00 a.m.**

Texas Instruments, Inc., Southwest Airmotive, and other Love Field facilities

[1] Paper not available—see box on page 135.

ASME Textile Engineering Conference, March 20-21, at North Carolina State College

The first Textile Engineering Conference of the Carolinas will be held on March 20-21, 1958, on the campus of North Carolina State College at Raleigh, N. C. The conference is sponsored by the Textile Engineering Division of The American Society of Mechanical Engineers and the East-Carolina, Piedmont, and Greenville, S. C., Sections in co-operation with the School of Engineering and the School of Textiles of North Carolina State College.

The theme of the conference is "Cost Control Through Engineering." Two general sessions will be held on the first day presenting papers devoted to engineering advancements in textile design and processing machinery. The session on the second day will be devoted to open forums on specialized textile-engineering topics. These forum sessions will each be moderated by competent specialists who will conduct a round-table discussion of the topic among the delegates present.

Included in the conference activities are tours of the laboratories and facilities of the Schools of Engineering and Textiles at North Carolina State College, the Thursday evening banquet and social hour, and a well-planned program of tours and socials for the wives of the delegates.

Availability of Papers

Only numbered ASME papers in this program are available in separate copy form until Jan. 1, 1959. Copies can be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 25 cents each to members of ASME, 50 cents each to nonmembers. Papers must be ordered by the paper numbers listed in this program, otherwise the order will be returned. The final listing of available technical papers will be found in the issue of Mechanical Engineering containing an account of the Conference.

▶ **THURSDAY, MARCH 20**

Registration **8:00 a.m.**

Session 1—The Textile Plant of Today and Tomorrow **9:30 a.m.**

Chairman: *John K. Whitfield*, chairman, East Carolina Section, ASME

Welcome: *J. H. Lampe*, dean, School of Engineering, N. C. State College and *Malcolm E. Campbell*, dean, School of Textiles, N. C. State College

Survey and Trends: Plant Design and Engineering,[1] by *W. A. Bowles*, Biberstein, Bowles and Meecham, Charlotte, N. C.

Developments in Plant Environment: Air Conditioning, Ventilation, Pneumatic Systems,[1] by *Agnew Bahnson, Jr.*, president, Bahnson Co., Winston-Salem, N. C.

Developments in Materials Handling,[1] by *J. C. Whitehurst*, James Hunter, Inc., Greenville, S. C.

Luncheon **12:30 p.m.**

Session 2—Engineering Advancements in Processing Machinery **2:00 p.m.**

Chairman: *E. M. Ketchie*, Ketchie-Houston Co., Concord, N. C.

Survey and Trends in Fiber and Yarn Processing Machinery,[1] by *N. M. Mitchell*, president, Barnes Textile Association, and chairman, Textile Engineering Division

Survey and Trends in Fabrics and Fabric Processing Machinery,[1] by *Kenneth Fox*, Fabric Research Laboratories, Boston, Mass.

Engineering in Textile Equipment,[1] by *Robert Pomeranz*, president, Roberts Co., Sanford, N. C.

The Frontiers of Research in Equipment Modernization,[1] by *J. F. Bogdan*, head of physical research, School of Textiles, N. C. State College

Social Hour **6:15 p.m.**

Banquet **7:00 p.m.**

Speaker: *William H. Ruffin*, president, Erwin Mills, Inc., Durham, N. C.

▶ **FRIDAY, MARCH 21**

Technical Discussion Groups —Informal round-table discussions by delegates **9:15 a.m.**

Group 1—Materials Handling

Moderator: *V. W. Cook*, manager, Charlotte Office of American Monorail Co.

Group 2—Nonwoven Materials

Moderator: *E. B. Grover*, head, department of fiber and yarn technology, School of Textiles, N. C. State College

Group 3—Warp Preparation

Moderator: *John Bodansky*, Cocker Machine and Foundry Co., Gastonia, N. C.

Group 4—Carding—Spinning Equipment

Moderator: *G. C. Anderson*, Saco-Lowell Shops Greensboro, N. C.

Group 5—Plant Planning and Layout

Moderator: *R. E. Dalton, Jr.*, Whitin Machine Works, Charlotte, N. C.

Group 6—Instrumentation

Moderator: *C. M. Asbill, Jr.*, School of Textiles, N. C. State College

Group 7—Industrial Engineering in the Textile Industry

Moderator: *D. E. Henderson*, vice-president, Roberts Co., Sanford, N. C.

Session 3 **11:00 a.m.**

Chairman: *William Newell*, co-ordinator, department of textile research, School of Textiles, N. C. State College

Summarizing reports by the moderators of the discussion groups concerning the comments, opinions, and conclusions of each group.

Campus Tours **2:00 p.m.**

Tours of the laboratories and facilities of the School of Engineering and the School of Textiles.

[1] Paper not available—see box on this page.

College of Forestry at Syracuse University to Be Host to Joint Wood Conference

THE Hugh P. Baker Laboratory of the New York State College of Forestry at Syracuse, N. Y., will be the focal point of a conference on basic and applied wood research to be held March 30–April 1, 1958. The conference, international in character, will be sponsored jointly by the Wood Industries Division of The American Society of Mechanical Engineers, and the Eastern Canadian Section and the Northeast Section of the Forest Products Research Society. Several hundred persons interested in research and in applied wood technology are expected to come from various parts of the United States and Canada. Recent pictures of Russia's forest industries will be shown.

The Baker Laboratory, completed in 1957 at a cost of nearly $4 million, was designed and equipped for education and research in wood. It brings together in one building modern machines and instruments for exploring the physical and chemical properties of wood—to increase the usefulness of wood products to man. A visit to the laboratory, where demonstrations of equipment and modern techniques will be held, will follow two days of technical sessions.

The modern Hotel Syracuse will be the conference headquarters. The technical sessions as well as the banquet will be held at the hotel. A program for the women is planned and a special Canadian Luncheon for all in attendance is contemplated.

A panel of authorities will discuss "Trouble Shooting in Gluing" and is expected to draw a large group of furniture people as well as those interested in wood fabricating. Another panel of specialists will discuss basic wood research.

Technical papers will cover laminated structures, particle board, wood-particle molding, new abrasives, performance of circular saws, and moisture movement in wood.

The tentative program follows:

▶ SUNDAY, MARCH 30

Registration and informal get-together — **7:00 p.m.**

▶ MONDAY, MARCH 31

Registration — **8:00 a.m.**

Session 1 — **9:00 a.m.**

Chairman: *E. A. Thompson*, Chairman, Eastern Canadian, FPRS

Film

Laminating Progress in Canada,[1] by *R. F. De Grace*, Canadian Institute of Timber Construction (FPRS Paper)

A Canadian's Camera View of Russia's Forest Industries,[1] by *J. H. Jenkins*, Forest Products Laboratories of Canada (FPRS Paper)

The Production of Bondwood,[1] by *T. H. Chapman*, Great Northern Woods (FPRS Paper)

Luncheon — **12:30 p.m.**

Welcome: *Hardy L. Shirley*, College of Forestry, State University of New York

Session 2 — **2:00 p.m.**

Chairman: *Rex Reynolds*, program chairman, ASME, Wood Industries Division

Film

Research in New Abrasives,[1] by *E. J. Sterba* Skil Corporation, Chicago, Ill. (ASME Paper No. 58—WDI-1)

Performance of Circular Saws,[1] by *R. J. Hoyle, Jr.*, College of Forestry, State University of New York (ASME Paper)

Cocktail Party — **5:30 p.m.**

Banquet — **6:30 p.m.**

Remarks: *Frank H. Kaufert*, president, Forest Products Research Society

A. W. Weber, vice-president, ASME, Region III

Panel Discussions (simultaneous) — **8:00 p.m.**

Basic Wood Research

Trouble Shooting in Gluing

▶ TUESDAY, APRIL 1

Session 3 — **9:00 a.m.**

Chairman: *J. Allan Hauter*, program chairman Northeast, FPRS

Film

The Mechanism of Moisture Movement in Beech,[1] by *Christen Skaar*, College of Forestry, State University of New York (FPRS Paper)

Granuplast Molding,[1] by *D. A. Watson*, Monsanto Chemical Co. (FPRS Paper)

The Baker Laboratory,[1] by *E. A. Anderson*, College of Forestry, State University of New York (FPRS Paper)

Annual Business Meeting, Northeast Section, FPRS — **12:00 p.m.**

Luncheon — **12:30 p.m.**

Inspection Trip — **2:00 p.m.**

Visit to Baker Laboratory, College of Forestry State University of New York

Demonstration of equipment and modern techniques

[1] Paper not available—see box on this page.

Ordering ASME Papers By Mail

ASME papers can be identified by numbers, e.g., 58—WDI-00. Only numbered ASME papers in this program are available in separate copy form until Jan. 1, 1959. Copies can be obtained by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 25 cents each to members of ASME and 50 cents to nonmembers. Papers must be ordered by the paper numbers listed in this program, otherwise the order will be returned.

FPRS Papers

Copies can be obtained by writing directly to the Forest Products Research Society, P. O. Box 2110, University Station, Madison 5, Wis.

Preliminary Program for ASME Maintenance and Plant Engineering Conference

THE Maintenance and Plant Engineering Conference which is to be held April 14 and 15 at the Penn-Sheraton Hotel, Pittsburgh, Pa., offers an interesting program.

This group, fairly new in The American Society of Mechanical Engineers, circle of activities, will present five technical papers, a panel discussion on maintenance, as well as a social program and an inspection trip.

The following comprises the preliminary program, with more in the planning stage:

▶ MONDAY, APRIL 14

Session 1 — **9:30 a.m.**

Chairman: *K. P. Powers*

Engineered Maintenance—A Tool of Management, by *H. W. Shockley*, consultant

Development of a Moderate-Sized Plant-Maintenance Organization, by *S. G. Hallett*, Continental Diamond Fiber Co. (Division of the Budd Co.)

Engineering Approach to Optimum Stores, by *R. E. Bley*, E. I. du Pont de Nemours & Co., Inc.

Luncheon — **12:30 p.m.**

Session 2 — **2:30 p.m.**

Chairman: *John Bryan*, vice-chairman, Executive Committee

Vibration and Balancing Problems in Maintenance, by *F. T. Buscarello*, Stewart-Warner Co.

Optical Tooling—Development and Industrial Applications, by *John Hanold*, Keuffel & Esser Co., and *H. R. Osmick*, E. I. du Pont de Nemours & Co., Inc.

Social Hour — **6:00 p.m.**

Banquet — **7:00 p.m.**

▶ TUESDAY, APRIL 15

Session 3 — **9:30 a.m.**

Chairman: *J. D. Quinn*, chairman, Program Committee

Maintenance Panel

O. W. Gravely, Union Carbide

W. E. Chandler, Monsanto

S. Whitehead, American Cyanamid

Plant Tour — **2:00 p.m.**

Fourth IRD Conference at University of Delaware, April 2–4

THE Instruments and Regulators Division of The American Society of Mechanical Engineers will hold its fourth annual conference at the University of Delaware, Newark, Del., April 2-4, 1958.

The conference plans to discuss the design and application of systems that automatically maximize yield efficiency, and performance, or minimize incremental cost. The Instrument Society of America, the Institute of Radio Engineers, and the American Institute of Chemical Engineers have joined the IRD in preparation for the conference, thus assuring an attendance of top engineers engaged in the measurement and control field in the United States and abroad.

The program offers five technical sessions and plant trips to Tidewater Oil's Delaware City refinery, E. I. du Pont de Nemours, Chrysler-Plymouth assembly plant, and Delaware Power and Light Generating Station. The Program Committee has arranged an attractive schedule for the women who plan to attend the meeting with their husbands.

The tentative program follows:

▶ WEDNESDAY, APRIL 2

Session 1 — **9:30 a.m.**

Chairman: *R. P. Bigliano*, E. I. du Pont de Nemours & Co., Inc.

Vice-Chairman: *J. N. Addoms*, Atlas Powder Co.

Optima—What They Are and How to Find Them,[1] by *G. E. P. Box*, Princeton University (ASME Paper)

An Approach to Self-Adaptive Controls,[1] by *C. F. Taylor*, Daystrom Systems Division (ISA Paper)

Evaluation of Strategies for Automatic Experimentation,[1] by *R. I. Van Nice* and *A. F. Kaupe*, Westinghouse Electric Corp. (ASME Paper)

Methods for the Realization of Self-Optimizing Systems,[1] by *M. J. Levin*, Columbia University (ISA Paper)

Session 2 — **2:30 p.m.**

Chairman: *J. M. Mazley*, Johns Hopkins Hospital

Vice-Chairman: *K. D. McGowan*, Hercules Powder Co.

Continuous Measurement of System Characteristics; A Step Toward Self-Optimizing Control,[1] by *T. P. Goodman* and *R. H. Hillsley*, Michigan Institute of Technology (ASME Paper No. 58—IRD-5)

A Technique for Optimizing Process Conditions,[1] by *A. L. Hoerl*, E. I. du Pont de Nemours & Co., Inc. (AIChE Paper)

Optimizing Transient Stability in Batch Processing,[1] by *D. P. Eckman* and *I. Lefkowitz*, Case Institute of Technology (ASME Paper)

Optimal Synthesis of Linear Sampling Control Systems Using Generalized Performance Indices,[1] by *R. E. Kalman*, International Business Machines Corp. (ASME Paper)

Session 3 — **8:00 p.m.**

Chairman: *J. R. Ragazzini*, head, Electrical Engineering Department, Columbia University

Panel Discussion—Problems and Opportunities in Designing Systems Which Automatically Optimize Performance

Y. T. Li, Aeronautical Engineering Department M.I.T.

H. H. Koppel, Research Department, Bailey Meter Co.

H. Groshkopf, American Cyanamid

Eugene Shapiro, International Business Machines Corp.

C. A. Laws, Elliott Brothers, London, England

▶ THURSDAY, APRIL 3

Session 4 — **9:30 a.m.**

Chairman: *W. E. Vannah*, Editor, *Control Engineering*, McGraw-Hill Publishing Co.

Vice-Chairman: *H. H. Hellerman*, University of Delaware

General

Dynamic Analysis of a Boiler, by *K. L. Chien, E. I. Ergin, C. Ling*, Beckman Systems Division, and *Allyn Lee*, Boiler & Heat Exchanger Branch, Navy Bureau of Ships (ASME Paper No. 58—IRD-4)

Gyro-Integrating Mass Flowmeter, by *L. T. Akeley, L. A. Batchelder* and *D. S. Cleveland*, General Electric Co. (ASME Paper No. 58—IRD-3)

Subharmonic Oscillations of Nonlinear Feedback-Control Systems,[1] by *K. Ogata*, University of Minnesota. (ASME Paper)

Time Domain Synthesis of Sampled-Data Control Systems,[1] by *E. I. Jury* and *F. W. Semelka*, University of California (ASME Paper)

Plant Trips — **2:00 p.m.**

Tidewater Oil Refinery

Delaware Power & Light—Edge Moor Station

Du Pont Company, Mechanical Development Laboratory. (This trip is limited to 30 people.)

Chrysler Motors Company, Plymouth Assembly Plant

Banquet — **7:30 p.m.**

[1] Paper not available—see box on this page.

▶ FRIDAY, APRIL 4

Session 5 — **9:30 a.m.**

Chairman: *E. M. Grabbe*, Ramo-Wooldridge Corp.

Vice-Chairman: *John E. Palmer*, Bendix Radio

An Optimalizing Computer Controller for the Electric-Utility Industry, by *L. K. Kirchmayer*, General Electric Co. (ASME Paper No. 58—IRD-2)

Impulse-Response Self-Optimization Compared With Other Criteria,[1] by *J. A. Aseltine, A. R. Mancini*, and *C. W. Sarturo*, Aeronutronics Systems (IRE Paper)

A Stochastic Model for Industrial Process Control,[1] by *J. R. McLaughlin*, Ramo-Wooldridge Corp. (IRE Paper)

An Adaptive Humidity-Control System, by *G. K. Tucker*, Brown Instruments Division, Minneapolis-Honeywell Regulator Co. (ASME Paper No. 58—IRD-1)

Advance Registration

REGISTRATION in advance for this conference is extremely important. The dormitories at the University of Delaware will be occupied by the conferees during Spring vacation.

Rooms and meals for the three days will be only $16 per person. The $16 will be required at least two weeks in advance in order to obtain accommodations at the University. By adhering to this strict advance guarantee the University is able to offer this price. The conferee risks having no accommodations available if he fails to register in advance.

Women are invited to attend, there will be no difficulty providing proper accommodations.

Ordering ASME Papers by Mail

ASME papers can be identified by the number 58—IRD-00. Only numbered ASME papers in this program are available in separate copy form until Feb. 1, 1959. Copies can be obtained by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 25 cents each to members of ASME and 50 cents to nonmembers. Papers must be ordered by the paper numbers listed in this program otherwise the order will be returned.

AIChE Papers

Copies can be obtained by writing directly to the American Institute of Chemical Engineers, 29 West 39th Street, New York 18, N. Y.

ISA Papers

Copies can be obtained by writing directly to the Instrument Society of America, 1319 Allegheny Avenue, Pittsburgh 33, Pa.

IRE Papers

Copies can be obtained by writing directly to the Institute of Radio Engineers, Inc., 1 East 79th Street, New York 21, N. Y.

1958 RAC Meetings Schedule

Date	*Day*	*Location*	*Hotel*	*Region*	*Section*
March 28–29	Fri.-Sat.	San Diego, Calif.	Kona Kai Club	VII	San Diego
Mar. 31–Apr. 1	Mon.-Tues.	Beaumont, Texas	Ridgewood Motor	VIII	Sabine
April 12–13	Sat.-Sun.	Nashville, Tenn.	Hermitage	IV	Chattanooga
April 17–18	Thurs.-Fri.	Ithaca, N. Y.	Statler	III	Southern Tier
April 21–22	Mon.-Tues.	Greensburg, Pa.	Mountain View	V	Westmoreland
April 25–26	Fri.-Sat.	Indianapolis, Ind.	Continental	VI	Central Indiana
April 28–29	Mon.-Tues.	Asbury Park, N. J.	Berkeley-Carteret	II	Mid-Jersey
May 9–10	Fri.-Sat.	Amherst, Mass.	Lord Jeffery Inn	I	Western Massachusetts

March 30, Palm Sunday
April 4, Good Friday
April 6, Easter Sunday

ASME, AIEE, IRE to Sponsor Joint Detroit Automatic Techniques Conference

Three-day forum to stress significant application techniques of automatic control in manufacturing and raw material processing industries

THE first Joint Conference on Automatic Control Techniques is scheduled to convene in Detroit, Mich., at the Hotel Statler, April 14-16, 1958. Under the co-direction of G. W. Heumann, chairman, AIEE Joint Division Committee on Automation and Data Processing, and Thomas H. Belcher, Michigan Section AIEE, the forum will include four technical sessions, a panel discussion, and an inspection trip.

In describing the function of the conference, Mr. Heumann said the meeting will bring together, for the first time, members of the principal professional engineering societies who are making use of electrical, electronic, mechanical, hydraulic, and pneumatic media to solve automatic control and data-handling problems for industrial production. While engineering considerations will dominate the technical sessions, heavy emphasis will be laid on improved performance resulting from the use of automatic control and data handling techniques, he added.

The program committee is composed of W. R. Harris (AIEE), *chairman*, F. D. Snyder (ASME), C. A. Priest (IRE), G. W. Knapp (AIEE), and A. R. Satullo (AIEE, Michigan Section). Mr. Harris reported that the papers (all of which are committed) will provide an outstanding program in terms of timeliness, diversification, and technical achievement.

Third U. S. National Congress of Applied Mechanics to Be in Providence

THE Third U. S. National Congress of Applied Mechanics will be held at Brown University, Providence, R. I., June 11–14, 1958. The congress program, which is to be distributed in May, will feature more than 100 papers in applied mechanics, including mechanics of rigid bodies, mechanics of deformable solids, mechanics of fluids and gases, thermodynamics, and heat transfer. In addition, there will be four general lectures by leading authorities.

To reduce the cost of attending the symposium to the utmost, the following all-inclusive living arrangement is offered. This covers rooms in the new West Quadrangle of Brown University, and all meals from breakfast on Wednesday, June 11, through luncheon on Saturday, June 14, but not the banquet on Thursday night. The rates will be $24 for each of two persons sharing a room, or $30 for a person occupying a single room. Rooms will be available without additional charge for Tuesday night and Saturday night. Please note that this arrangement was only made possible by excluding all deviating arrangements for those planning to live on the Brown campus. Those planning to stay at hotels or motels will be able to lunch in the Brown Refectory at the price of $1.50 per luncheon. The banquet ticket will be $5.

Registration Fees. Advance Registration on or before June 7th is $4. Registration on June 8th or later, $6.

Please make checks payable to: APPLIED MECHANICS CONGRESS.

Requests for copies of the program and letters concerning advance registration should be addressed to Miss E. M. Addison, Box F, Brown University, Providence 12, R. I. In registering, please indicate number of persons in party and family relationship, desire for single rooms or willingness to share rooms, estimated arrival and departure times, and need for parking space.

ASME Materials Handling Handbook Available

A NEW volume on materials handling, probably the most complete reference work available on the subject, was published in January, 1958. Prepared under the sponsorship of the American Material Handling Society and the Materials Handling Division of The American Society of Mechanical Engineers, "The Materials Handling Handbook" is edited by Harold A. Bolz, Mem. ASME, associate dean of the College of Engineering at The Ohio State University. Associate Editor is George E. Hagemann, past-chairman of the ASME Materials Handling Division.

The project, in preparation for more than five years, was under the direction of a joint committee of ASME and AMHS members whose chairman is Herbert H. Hall, Mem. ASME, retired from the Aluminum Company of America.

The 1750-page volume contains a record of virtually all of the progress made up to this point in materials handling.

Copiously illustrated with photographs, charts, tables, and diagrams, it is divided into 47 sections covering methods of analyzing handling problems, principles, procedures, and techniques for effective operation and control; systems design and installation; integration of materials-handling activities with the manufacturing processes; and the design, selection, and classification of materials-handling equipment. All types of conveyers, winches, cranes, powered and hand trucks, marine, air, and railroad carriers and terminals, and warehouse and yard handling are included. There is also a section on using predetermined data and setting up the job-related training program, including organization instruction, sample tests, and hints for avoiding failures.

Each section has its own table of contents. Important words and phrases in the text are set in bold face. All sections, of which a list follows, have been handled by one or more of the 84 authoritative contributing and consulting editors.

List of sections: Air Carriers; Air Terminal Handling; Analyzing Materials Handling Problems; Auxiliary Crane Equipment; Belt Conveyors; Cable Conveyors; Chain Conveyors; Communications Systems; Definition and Scope of Materials Handling; Elevating Conveyors; Elevators; Factory Planning; Fixed Cranes, Derricks and Cableways; Handling Bulk Materials; Haulage Conveyors; Highway Trucks and Truck-Trailers; Industrial Hand Trucks; Industrial Packaging; Industrial Tractors; In-Process Handling of Bulk Materials; Marine Carriers; Marine Terminal Handling; Materials Handling and Production Control; Materials Handling Factors; Materials Handling Research; Materials Positioning in Production; Package Conveyors; Palletization; Pallets and Containers; Pneumatic Conveyors; Portable Conveyors; Portable Cranes; Positioning Equipment; Powered Industrial Trucks; Railroad Freight Cars; Railroad Terminal Handling; Scrap Classification and Handling; Training Personnel; Traveling Cranes and Towers; Trolley Conveyors; Truck Terminal Handling; Unit Handling for Various Shapes; Unit Handling in Manufacturing; Uses of Containers in Industry; Vibrating and Oscillating Conveyors; Warehousing and Yard Handling; Winches.

"The Materials Handling Handbook" is published by the Ronald Press, New York, N. Y., and is priced at $20. Members of ASME and AMHS may obtain copies of the book at a 20 per cent discount.

Conducted for the National Junior Committee

N. J. VIEHMANN

JUNIOR FORUM

Will Engineering Attain the Status of a "Learned" Profession?

In the movement to create an attitude of unity among engineers toward their calling, the Engineers' Council for Professional Development has endeavored to give a specific meaning to the term professional as it is to be applied to engineers.

William E. Wickenden in "A Professional Guide for Junior Engineers" asserts that modern usage is increasingly restricting the term to a learned calling.

Dr. Wickenden put much into the meaning of the term profession which he defines as "an occupation which:

1 Renders a specialized service based upon advanced specialized knowledge and skill, and dealing with its problems primarily on an intellectual plane rather than on a physical or a manual-labor plane.

2 Involves a confidential relationship between a practitioner and a client or employer.

3 Is charged with a substantial degree of public obligation, by virtue of its possession of specialized knowledge.

4 Enjoys a common heritage of knowledge, skill, and status to the cumulative store of which professional men are bound to contribute through their individual and collective efforts.

5 Performs its services to a substantial degree in the general public interest, receiving its compensation through limited fees rather than through direct profit from the improvements in goods, services, or knowledge which it accomplishes.

6 Is bound by a distinctive ethical code in its relationships with clients, colleagues, and the public." The Detroit Industry Training Committee (ECPD) in one of its six Engineering Training Program booklets quotes Clement J. Freund, Fellow ASME, dean of the College of Engineering, University of Detroit, as saying: "The principal characteristic of the professional man is that he commands the confidence of people who retain or engage him. He commands their confidence by his competence and his integrity . . . . Not only are the competence and skill of the professional man beyond the reach of the average man, they are beyond his comprehension. . . . The engineer must be honest and upright. He must have a cultivated moral judgment . . . my confidence (in him) will depend upon his reputation for honesty and integrity . . . "[2]

Engineers most certainly recognize that they must demonstrate specialized competence and rigorous integrity as a group before they will be regarded as members of a learned profession by the general public.

The learned professions, as they exist today, have other unique characteristics, three of which seem to be of particular importance to any group that may aspire to attain recognition in a learned profession. The act of organizing these professions benefited the public welfare. It may be said that the organization of both the American Medical Association and the American Bar Association was undertaken in that spirit.

Commonly three to four years of liberal arts education at college level precede the

[1] Development engineer, Western Electric Company, North Andover, Mass. Assoc. Mem. ASME.

[2] Address before Engineers' Council for Professional Development, 23rd Annual Meeting, Oct. 13, 1955, Toronto, Ont., Canada.

LET'S MAKE THE FORUM A FORUM!

Your comments on this month's or previous articles, or other pertinent topics are invited. Please write Junior Forum, c/o N. J. Viehmann, Department 753, Western Electric Company, North Andover, Mass.

general education for the legal and medical profession. Education for a specialized field within these professions begins after six or seven years of college training have been successfully completed. It is of particular interest that the medical profession has found it necessary to require at least an internship and in some instances a residency in clinical training as well before it will admit a candidate to its professional ranks.

Will the organization of engineers as a unified professional group be of benefit to the public good?

Municipal, state, and federal building and safety codes guard against poor engineering practice in the fields of construction and industrial safety. Competition demands sound engineering practice when it comes to consumer goods and to most industrial goods. Because competition demands it, business management demands good engineering practice. Consulting engineers, however, might be placed in a category with doctors and lawyers.

Apart from the obvious advantages to both the public and to engineers of maintaining high ethical standards among those who practice enginering there is a great and present public need that could be satisfied by engineers acting in a body as a unified engineering profession. The need, which is of utmost importance to the National Defense, is that we, in America, provide not merely adequate training for engineers but the best in the world.

Typical of the recent accent on the shortcomings of engineering education are the comments made by four engineering executives in the November 4 issue of *Product Engineering*. The complaints are not new. They proclaim that young engineers are: (1) unable to express themselves orally or in writing, or even to read with precise understanding; (2) are lacking in an understanding of basic human relations and are limited in the arts; and (3) are frequently weak in fundamental concepts of science and mathematics and lack facility in advanced mathematics techniques.

Industry in general is demanding more of the engineer than it has in the past. This is apparent not only in what we read in magazines but in our personal experiences. Gradually the efforts of some of the engineering societies and their joint committees are being directed at the problem of improving engineering education.

The hope for the establishment of a veritable engineering profession seems to lie in the establishment of a unified effort by engineers to develop and provide a universal program for engineering education that will produce engineers worthy of the title professional in its highest sense, and who will be recipients of the respect of experienced engineers rather than the objects of their discontent.

ASME CODES AND STANDARDS WORKSHOP

Elevator Safety Code Revisions Approved

Revisions to the American Standard Safety Code for Elevators, Dumbwaiters, and Escalators, ASA A17.1-1955, were approved by the American Standards Association, Dec. 10, 1957. These revisions are available in pamphlet form under the title "Supplement to American Standard Safety Code for Elevators, Dumbwaiters, and Escalators," ASA A17.1a-1957.

Most of the revisions are clarifications of phrasing and intent, but a considerable number are technical and were made as a result of experience in the application of the 1955 rules by a number of jurisdictions. both state and city, which utilized A17.1-1955 in their local codes. Some changes resulted from careful analysis of accident records over the previous eight years. Chief among these are revisions which permit the newer types of automatic, operatorless elevators in office buildings, especially the automatic traffic-pattern operation. Additional safety requirements as to overload capacity have been developed.

Probably one of the most important changes is the permission for installation of emergency access keys at the hoistway door under certain circumstances. Previously this was prohibited.

The Supplement is 20 pages, priced at $1 a copy, with 20 per cent discount to ASME members, and can be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

G. H. Stimson is appointed to Standardization Committee

G. H. Stimson Appointed Member of Standardization Committee

Glen H. Stimson, Mem. ASME, Greenfield Tap & Die Corporation, has been appointed member of the Standardization Committee for a five-year term, succeeding retiring chairman F. P. Tisch, Mem. ASME. Mr. Stimson has been a member of the Society since 1939.

His work on the Society's standardizing committees includes membership on Sectional Committee B4, Allowances and Tolerances for Cylindrical Parts; Sectional Committee B1, Standardization and Unification of Screw Threads; and Sectional Committee B2, Pipe Threads; and several subcommittees under these sectional committees.

New Standards

The following have been approved by the American Standards Association and are available from the ASME Order Department:

Letter Symbols for Heat and Thermodynamics (Y10), $1.50;

Graphical Symbols for Use on Railroad Maps and Profiles (Y32), $1.50;

Markings for Grinding Wheels (B5), $1; and

Safety Code for Conveyors (B20), $1.50.

New Projects

Sectional Committee S2, Mechanical Shock and Vibration, is one of three made from the former Sectional Committee Z24. S2 is cosponsored by the Society and held its first meeting December 5, during the ASME Annual Meeting.

As a result of investigation and request by the ASA Chemical Industry Advisory Board, Sectional Committee B16, Pipe Flanges and Fittings, has established a new subcommittee, Subcommittee 10, on Pressure-Vessel Flanges, under the chairmanship of Meade McArdle, Olin Mathieson Chemical Corporation. The subcommittee is charged with establishing standards for large pressure-vessel flanges acceptable under the ASME Boiler and Pressure Vessel Code.

At its meeting December 5, Sectional Committee B5 authorized a new subcommittee, TC19, to prepare a standard on spindle noses for precision boring machines, for the purpose of establishing interchangeability. The chairman of the committee is E. A. Goddard, Mem. ASME, Goddard & Goddard Company.

During the Annual Meeting, 48 standards and codes meetings were held, including:

12 Power Test Code Technical Committee Meetings; Sectional Committee B16 on Pipe Flanges and Fittings; Sectional Committee B5 on Small Tools and Machine Tool Elements; Sectional Committee B31 on Code for Pressure Piping; Sectional Committee B32 on Wire and Sheet-Metal Gages; Sectional Committee Y14 on Drawings and Drafting Room Practice; Sectional Committee S2 on Mechanical Shock and Vibration; Standardization Committee; and Power Test Code Main Committee.

ASME COMING EVENTS

March 2–6

ASME Gas Turbine Power Conference and Exhibit, Shoreham Hotel, Washington, D. C.

March 16–22

Nuclear Congress, International Amphitheater, Chicago, Ill. (ASME is cosponsor)

March 16–20

ASME-ARS Joint Aviation Conference, Hotel Statler-Hilton, Dallas, Texas

March 19–20

ASME-AIEE Engineering Management Conference, Somerset Hotel, Boston, Mass.

March 20–21

ASME Textile Engineering Conference, North Carolina State College, Raleigh, N. C.

March 30–April 1

ASME-FPRS Joint Wood Industries Conference, Syracuse University, Syracuse, N. Y.

April 2–4

ASME Instruments and Regulators Conference, University of Delaware, Newark, Del.

April 9–10

ASME-AIEE Railroad Conference, Hotel Statler, Cleveland, Ohio

April 10

ASME Production Engineering Conference, Hotel Bancroft, Worcester, Mass.

April 14–15

ASME Maintenance and Plant Engineering Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

April 14–17

ASME Design Engineering Conference, International Amphitheater, Chicago, Ill.

April 15–17

ASME-AWS Metals Engineering Joint Conference, Hotel Statler, St. Louis, Mo.

April 24–25

ASME-SAM Management Conference, Hotel Statler, New York, N. Y.

May 11–15

ASME Oil and Gas Power Conference and Exhibit, Bellevue-Stratford Hotel, Philadelphia, Pa.

June 9–12

ASME Materials Handling Conference, Cleveland Auditorium, Cleveland, Ohio

June 11–14

Third U. S. Congress of Theoretical and Applied Mechanics, Brown University, Providence, R. I. (ASME is cosponsor.)

June 15–19

ASME Semi-Annual Meeting, Hotel Statler, Detroit, Mich.

Note: Members wishing to prepare a paper for presentation at ASME national meetings or divisional conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for which there is no charge providing you state that you are a member of ASME.

(*For Meetings of Other Societies, see page 132*)

ACTIONS ASME EXECUTIVE COMMITTEE

1958 Society Records Sent Upon Request

MEMBERS of The American Society of Mechanical Engineers who wish to receive a copy of February, 1958, issue of Society Records containing the personnel of the Council, Boards, and Committees (AC-10) may do so by requesting the pamphlet from the Secretary, ASME, 29 West 39th Street, New York 18, N. Y.

A MEETING of the Executive Committee of the Council of The American Society of Mechanical Engineers was held in the rooms of the Society, New York, N. Y., Jan. 3, 1958, with J. N. Landis, chairman, presiding. In addition to Mr. Landis there were present: E. W. Allardt, C. E. Crede, L. N. Rowley, and G. B. Warren, of the Executive Committee; W. H. Byrne and A. W. Weber, vice-presidents; Joseph Pope and V. Weaver Smith, directors; E. J. Kates, treasurer, and H. J. Bauer, assistant treasurer; O. B. Schier, II, secretary; T. A. Marshall, Jr., senior assistant secretary; D. C. A. Bosworth, W. E. Reaser, and S. A. Tucker, assistant secretaries; and Ernest Hartford, consultant.

The following actions of the Executive Committee are of general interest.

Death of James W. Parker. The Executive committee noted with regret the sudden death, on Dec. 30, 1957, of James W. Parker, Fellow, past-president, and Hon. Mem. ASME. R. G. Folsom, G. H. Howell, A. C. Pasini, and P. W. Thompson represented the Society as honorary vice-presidents at the funeral services on Jan 2, 1958, and C. E. Davies served as honorary pallbearer.

Sections. Affiliation of the ASME East Tennessee Section with the Technical Societies Joint Council of Oak Ridge, Tenn., was approved.

Certificates. The following special certificates were authorized: Carleton Allen Read, a member for 65 years; William F. Durand, member for 75 years; Henry Marx, member for 78 years. (The name of Henry Marx appears in the first catalog of ASME, issued September,

1880, as a Junior Member. He was transferred to Member grade in 1892.)

The following certificates were granted for services on the Committees, Boards, and Sections named: George M. Muschamp (Organization Committee); Louis G. Smith (Constitution and By-Laws Committee); John O. Amstuz (Finance Committee); Robert H. Bacon (Board on Technology); D. H. Cornell (Professional Divisions Committee); W. E. Reaser (Publications Committee); Frank P. Tisch (Standardization Committee); Norman A. Parker (Education Committee); Warren R. Thompson (National Junior Committee); C. N. Spencer (East Tennessee Section); Howard W. Butler (Hartford Section); Harry R. Fulton (Pittsburgh Section); C. Wayne McCreery (Toledo Section); Sidney H. Acker (Nashville Subsection of Chattanooga Section); Robert J. Hazelrigg (Minnesota Section); and Chester J. Lipinski (Toledo Section).

Student Sections. Establishment of an ASME Student Section at Union College, Schenectady, N. Y., was approved.

Engineers Joint Council. The Executive Committee approved the changed EJC membership status of the American Institute of Industrial Engineers from associate society to constituent society.

Pratt Institute Advisory Council. It was reported that the editor of the Society, J. J. Jaklitsch, Jr., has become a member of the Pratt Institute Advisory Council.

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC
[Agency]

THESE items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

NEW YORK	CHICAGO	DETROIT	SAN FRANCISCO
8 West 40 St.	84 East Randolph St.	100 Farnsworth Ave.	57 Post St.

Men Available[1]

Industrial Engineer, degree in Administrative Engineering, 39; five years' experience in time study and manufacturing engineering in machine shop and sheet-metal fabrication, standard data, and contract negotiations, and grievance procedures. Prefers N. C. ME-500.

Sales Engineer, BSME, 30; six years' manufacturing and production-development experience in electronics and mechanical industries. Registered PE. Part-time lecturer in industrial management at local university. Prefers East. ME-501.

Sales Manager, 55; specialized, technical equipment, 15 years' successful experience promoting sales specialized equipment. Prefers East or West Coast. ME-502.

Plant-Maintenance Engineer, MSc; 42, 20 years' marine, chemical, and heavy-medium engineering, management and administrative experience, and commercial training. Traveled and employed Canada, South Africa. Prefers N. Y. State, Conn., or Pa. ME-503.

Administrative Engineer, BSIA, 33. Nine years factory management; product-process development; planning; budgets, cost, and schedule control; plant layout, design; time study, methods; operations analysis; supervision of engineering service department; labor relations. Prefers Conn., New York City suburbs. ME-504.

Design Engineer, BME, 32; six years design hydraulic-test equipment for aircraft components and jet-engine accessories. Technical and specification writing. Prefers East. ME-505.

Supervisory Engineer, BSME, 40; 17 years' experience in design and management having various positions up to and including chief engineer, well versed in special machinery, light and heavy, oil hydraulics and electrical control. Professional license. Prefers Midwest. ME-506.

Mechanical Engineer, ME, 35; design and research engineer, six years' experience molds for injection molding, hydraulic mechanisms, strength of materials, design of small mechanisms. Heat-transfer calculations. Nonmilitary products. Prefers N. Y. ME-507.

Manufacturing Research, MSME, 39; 12 years' experience in manufacturing research on evaluation of cutting fluids, grinding fluids, cutting tools and grinding wheels, high-temperature alloys, titanium, and alloy steels. Prefers East, South, Midwest. ME-508-9501-Detroit.

Chief Engineer, MME, 36, 14 years in design, development, and manufacturing of air-condition and heat-transfer equipment. Included in this is several years of teaching in thermodynamics and consulting in allied fields. Willing to relocate. ME-509-852-Chicago.

Plant-Methods Engineer, BSIE, 35, seven years' varied experience in time study, incentives and day-work systems, job analysis, methods, standard cost, systems and procedures, estimating, and plant layout. Have developed and installed complete standard-data programs and participated in union and management grievances. Experience in job-order shops and mass-production methods. Report directly to plant manager. Prefers N. Y., N. J., or eastern Pa. ME-510.

Mechanical Engineer, BSIE, MSME, 30. French, German, Spanish. Four years application and sales of pumps, engines, compressors; co-ordinating steam power-plant projects; two years heat transfer, fluid flow, mechanical design, proposals, administrative matters. Prefers N. Y. area; will relocate. ME-511.

Mechanical Engineer, BME, PE, 30. Ten years development, research, supervision in mechanical and electromechanical fields. Prefers greater New York area or West Coast. ME-512.

Positions Available

Industrial Engineers. (*a*) Project engineers, six to ten years' experience in line operating, time and motion, standard hour, methods, new and revised installations plant layout, flow process, statistics, etc. Prefer basic experience in steel, textile, or steel fabricating. Pa. (*b*) Plant-industrial engineers, two to four years' experience in line operating, time and motion, standard hour with direct and indirect application and labor-cost analysis, methods, etc. Prefer men with textile background which would be standard-minute experience. Salaries open. Miss., N. C., and Conn. W-5662.

Engineering Statistician, IE degree and graduate training in mathematical statistics and four or more years' experience in application of mathematical and statistical techniques to engineering, research, or management problems, for statistical design and analysis of research, development, and plant experiments, market surveys, and quality-control plans; application of probability theory and statistical inference to production and management problems; development and promotion of mathematical techniques. To start, $7800–$8900. Company pays placement fee. N. J. W-5671.

Production Engineer, 30 and over, BS(ME) or EE, at least five years' experience. Working knowledge of quality control, mechanical, electrical, and chemical principles for the engineering of company products to meet requirements as to cost and quality and for the maintenance of company manufacturing policies. About $7000. Westchester County, N. Y. W-5681(*a*).

Sales Personnel. (*a*) Assistant to sales manager, mechanical graduate, process-equipment and field-sales experience in pharmaceutical and biological fields, to take charge of equipment, technical service, preparation of special quotations. $7500–$9000. (*b*) Sales representatives, engineering training and process-equipment-sales experience through distributors and direct to drug and allied manufacturers. $7000–$8500. (*a*) Pa.; (*b*) One for South, one for the Midwest. W-5688.

Chief Design Engineer, 32–40, mechanical, electrical, or aeronautical-engineering graduate, at least five years' administrative, supervisory design, and product-engineering experience covering air-conditioning and air-handling equipment, controls, regulators, and accessories. $10,000. Conn. W-5697.

Power Engineer, broad experience in steam generation; must be graduate mechanical. Experience should include engineering on boilers, pumps, refrigeration, compressors, and piping systems. Apply by letter including complete résumé. Midwest. W-5700.

Control-Valve-Design Engineer, to take responsibility for design of pressure and temperature-regulator valves, testing models, getting into production, liaison with sales, etc. Salary open. Ohio. W-5701.

Professor, to act as head of industrial engineering department, and engineering drawing, with master's degree in industrial engineering and some industrial experience. Contract on a nine-month basis with possibility of six-week term in summer school in addition. Available Feb. 1, 1958. Southwest. W-5702.

Sales Manager. Must be thoroughly experienced sales executive, comprehensive wire-and-cable industry background. Will report directly to vice-president—sales and will be responsible for administration and managerial aspect of entire sales department. Previous experience as regional or district sales manager, assistant sales manager, etc., desirable. To start, $9000–$10,000, depending on experience and other qualifications. Conn. W-5703.

Instructor, engineering degree, teaching, or industrial experience to teach tool and machine design, mechanics of materials, production and

[1] All men listed hold some form of ASME membership.

processes, and strength of materials. $6000. New York metropolitan area. W-5705.

Mechanical Engineer, ME degree, minimum of three to five years' experience including maintenance and construction work. Will be under supervision of superintendent of engineering, to establish preventive maintenance programs for all mechanical equipment, repair and maintenance of all diesel equipment, supervision of all mechanical-shop activities, including machine shop, foundry, and locomotive repairs. $8400. Honduras. F-5708(*b*).

Assistant to Vice-President and Factory Manager, 30–40, ME degree, at least five years' experience in the production of large machinery, and experience in the manufacture of high-speed rotative equipment such as turbines, pumps, compressors, etc. Some experience or education in cost accounting, personnel administration, machine-shop practice would be valuable. $8000–$11,000. Conn. W-5712.

Mechanical Engineer, three years' experience in materials-handling systems and experience in design and specifications, customer and supplier contacts and supervision for direction of the installation of liquid and dry-sugar conveying systems at customers' plants including design and pricing. New York, N. Y. W-5723.

Patent Engineer, ME or EE graduate, patent office experience covering devices, equipment, and improvements. $10,000–$12,000, plus bonus. N. Y. W-5724.

Assistant Professor, BS or MS, to teach mechanics of materials. $4500–$5300. Foreign. F-5725(*a*).

Tool Engineer, BS(ME) or equivalent, to 40, six years' experience in designing progressive dies for metal stamping and some experience with plastic molding dies. $8000–$9500, plus fringe benefits. Company will pay placement fee. Pa. W-5726.

Chief Engineer, experience in the planning, tooling, and operation of a motorbike factory and who understands product design from the standpoint of reduction of cost and ease of production. $12,000. Europe. F-5728.

Assistant to President, ME or IE preferably with MS in Business Administration for managerial production experience in process industry, i.e., in natural fiber or mineral-products field. Salary open. Carribbean area. F-5733.

Assistant or Associate Professor, ME or PhD in mechanical engineering; to teach thermodynamics, vibrations, and mechanical-engineering laboratory. Rank and salary commensurate with qualifications. Positions available March or September, 1958. Midwest. W-5736.

Senior Engineer-Design, BS, AE, or ME, five or more years in preliminary design or proposal writing and presentation, for aircraft and missile industry. Salary open. Ohio. W-5738(*a*).

Chief Engineer, 35–45, for company in metal-products field, auto hardware, etc. for new product design and development, development and engineering department, small company. $10,000–$15,000. New York. W-5741.

Engineering Manager, for large company manufacturing testing and control equipment, i.e., weight measurements, dynamic tests, etc. Will direct the work of chief engineers, analyze engineering talent, and business part of engineering products. $15,000–$18,000. Northeast. W-5743.

Assistant Technical Director, BSME, 30–40, five to ten years product design and development, at least some experience in the oil, gas, and petrochemical industry. $10,000–$12,000. La. W-5745.

Engineers. (*a*) Manufacturing engineer, to work closely with department manager on problems such as processing, layout, handling equipment, fixture design, tool control, new machine specifications, and a variety of long-range production plans. (*b*) Tool design supervisor, five to ten years' experience on tool design and some supervisory experience; to supervise a tool design and drafting section composed of ten tool designers and draftsmen working on tools and dies for forming, forging, welding, and machining of ferrous products. Will follow designs through tooling layout. Salary open. Pa. W-5747.

Manager, Industrial Sales, graduate, to 35. Experience in the sale air-handling equipment to industrials would be especially valuable. Heat-transfer and refrigeration experience will also be desirable. Should have sales management experience in industrial sales. Salary open. Midwest. W-5749.

Works Manager, 40–50, graduate engineer, to take complete charge of 800-man sheet-metal

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

Please Print

ASME Master-File Information

Date

LAST NAME _____ FIRST NAME _____ MIDDLE NAME _____

POSITION TITLE _____ NATURE OF WORK DONE _____

e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) _____ Division, if any _____

*☐

EMPLOYER'S ADDRESS _____ City _____ Zone _____ State _____

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER; e.g. Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

*☐

HOME ADDRESS _____ City _____ Zone _____ State _____

☐

PRIOR HOME ADDRESS _____ City _____ Zone _____ State _____

* CHECK "FOR MAIL" ADDRESS

Address changes effective when received prior to:

I subscribe to

☐ MECHANICAL ENGINEERING	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

☐ A—Aviation	☐ J—Metals Engineering	☐ S—Power
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ T—Textile
☐ C—Management	☐ L—Process Industries	☐ U—Maintenance and Plant Engineering
☐ D—Materials Handling	☐ M—Production Engineering	☐ V—Gas Turbine Power
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ W—Wood Industries
☐ F—Fuels	☐ O—Lubrication	☐ Y—Rubber and Plastics
☐ G—Safety	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ H—Hydraulics	☐ Q—Nuclear Engineering	
	☐ R—Railroad	

plant, 11-18 gage. Will supervise production, control, engineering, purchasing, etc. Must have ten years' administration experience. $10,000–$20,000. Pa. W-5750.

Instructor of Engineering Graphics, to solve problems based on the principles of orthographic projection, descriptive geometry, and mathematics including graphical differentiation and integration. Will be able to study for master's degree. Position available February, 1958, or September, 1958. N. Y. State. W-5751.

Instructor, engineering graduate, to teach engineering drawing and descriptive geometry, and at the same time have an opportunity to work towards a master's degree at state university. Salary depends on background and experience. Midwest. W-5757.

Project Mechanical Engineer, ME, graduate, at least five years' special machinery design, specification and installation experience covering large radars and motor-driven equipment including structural stress-analysis work. $10,000. New York, N. Y. W-5762.

District Sales Manager, 35–45, mechanical-engineering training and at least five years' industrial sales and office management experience covering sale of bearings and other instruments components through manufacturers agents. $8000–$10,000. Midwest. W-5763.

Plant Manager, Mechanical Engineer, at least ten years' production and managerial experience covering industrial boilers, heat exchangers, and fabricated steel products. Either Portuguese, Spanish, or German desirable but not essential. $15,000–$18,000, plus bonus, housing, and transportation. Brazil. F-5765.

Plant Manager, preferably IE, to reorganize graphic arts plant. Leadership qualities are paramount with background in promotion, systems, methods; personnel relations extremely important. Salary open. Apply by letter stating minimum salary. Pa. W-5766.

Staff Consultant, Management Controls, engineering graduate, preferably with advanced courses in business administration and three to five years' experience covering budgets, standard costs, and various financial controls. Moderate traveling. $8000–$12,000. New York, N. Y. W-5770.

Sales Training Director, 28–35, engineering degree, two to three years' instruction experience and additional industrial experience in test training, sales, and promotional work covering electrical instruments, controls, and components. $7500–$9000. Northern N. J. W-5777.

Designer-Product Mechanical or Electrical, five or more years in design of electromechanical devices. Very little board work—only preliminary sketches. One-man department responsible for design of instruments and meters. Good potential for a manufacturer. $9000–$10,000, depending on experience. Employer will pay placement fee. Mich. C-6637

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

THE application of each of the candidates listed below is to be voted on after Feb. 25, 1958, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and • Transfers

Alabama

MURPHY, LEONARD C., Birmingham
NALL, KENNETH L., Decatur
•SUMMERS, BERNARD D., Birmingham

Arizona

PETERSON, JAMES R., Phoenix

Arkansas

PFEIFFER, WILLIAM E., Little Rock

California

ALFORD, HERMAN B., Santa Fe Springs
BORBOR, HAMID, Laguna Beach
CUMBY, CHARLES, JR., Pasadena
DAWSON, WYATT W., Los Angeles
FRENCH, BALLARD D., Red Wood City
KAO, PAUL W., South Gate
LADWIG, NEAL G., Pasadena
MACKENZIE, DONALD J., Los Angeles
REISMAN, ARNOLD, Los Angeles
•SPECHT, EDWARD J., Pasadena
•WEISMAN, CHAUNCEY, Los Angeles

Colorado

STRICKLAND, JOHN W., Denver
WILLIAMS, ROBERT J., Boulder

Connecticut

CLARKE, RICHARD G., Hartford
•ERICKSON, WALTER B., New Britain
GEBHARDT, ADOLPH A., Fairfield
GEER, HENRY P., Bridgeport
JEPSON, JOHN W., New Haven
PFANNEBECKER, GEORGE W., Middletown
SWEET, RAY D., Bridgeport

Delaware

WEED, JOSEPH D., Wilmington

District of Columbia

BROOKS, LEON O., Washington
WATTS, NICHOLAS W., Washington

Florida

BANE, CURTIS G., Panama City
MCGRAW, CHARLES T., Panama City
MILLER, FLOYD A., Pensacola
•MITCHELL, ROBERT M., JR., Miami

Illinois

•BUMP, THOMAS R., Western Springs
HOFFMAN, RICHARD E., Chicago

•Transfer to Member or Affiliate.

JELENC, ANTHONY F., Glen Ellyn
LOOMIS, EVERETT W., Springfield
NOLAN, RONALD A., Chicago
PADOVE, SEYMOUR, Chicago
PENZIAS, WALTER, Harvey

Indiana

JORDAN, J. PAUL, Mishawaka
OAKES, MYRON D., Lawrenceburg
SCHOOLEY, RALPH E., Indianapolis
SEARLES, JAMES M., Evansville
•STAAK, LOUIS E., Fort Wayne

Iowa

•PETERSON, CLAUDE E., Iowa City

Kentucky

•ALLPORT, J. DAVIES, Franklin
GEORGE, HENRY H., Louisville

Maryland

CARVEN, JOHN P., Bethesda
FINN, LAWRENCE H., Baltimore
MOZLEY, JAMES M., Baltimore

Massachusetts

ANDERSON, FREDERICK A., Worcester
CRAM, ROBERT D., Manchester
CURWEN, DARCY, Boston
HARPSTER, WILLIAM F., Framingham
KOVACH, LESLIE J., Leominster
MACIEJEWSKI, LEO S., Boston
MYSKOWSKI, LEO J., Boston
SHEDDEN, EVERETT C., Peabody
•ZWIEP, DONALD N., Worcester

Michigan

•DAMM, VICTOR W., Niles
SECORD, JOHN R., Detroit

Minnesota

JAMES, BRUCE A., Minneapolis
•JANSSEN, JOHN E., Hopkins

Missouri

BRUCE, RICHARD K., Grandview
•NELSON, FRANCIS S., Kansas City
RENSHAW, EDWARD, St. Louis
SORKIN, BURTON, University City
•STROHL, GEORGE W., Kirkwood
WALLACE, FLOYD C., Kansas City

New Jersey

ALLEBACH, WILMER K., Newark
BANZON, JOAQUIN T., Trenton
EISENTRAUT, RUDOLPH A., Murray Hill
HAMOR, RUSSELL H., JR., Hazlet
HART, BERNARD P., Hillsdale
HERTAN, MARVIN C., Passaic
KELCEC, GEORGE, South Amboy
KONG, SING J., Waldwick
LARSEN, LOUIS T., Plainfield
MASSEY, HAROLD, W. Englewood
NASHMAN, MORTON P., Nutley
POWERS, JOSEPH P., Boonton
RICHART, ARTHUR W., Packanack Lake
SZCZEPANIK, JOHN A., Jersey City
TUTKO, ALBERT J., Newark
VIEGAS, JOHN J., Bergenfield
WANASELJA, HAROLD, Weehawken

New Mexico

NORTH, ERNEST E., Albuquerque

New York

BONDANI, ROLAND, Bronx
CHAMBLISS, JOSEPH M., Kenmore
CLARK, KENNETH M., Wellsville
•COLANGELO, CHARLES W., Mineola
CONGER, ALLEN C., New York
DESMOND, EDMUND A., Little Falls
FELDSTEIN, GEORGE, Brooklyn
GIFFORD, JOHN R., New York
HANSEN, FREDE, Painted Post
HEDDEN, OWEN F., Staten Island
HIGHT, NORTON F., Brooklyn
HUNT, FRANCIS E., Utica
JOHNSON, RAY C., Rochester
•LORB, WILLIAM A., Chappaqua
MARSHALL, HERMAN S., Wellsville
MENDELMAN, RICHARD V., Hicksville
•MORTON, DONALD S., New York
MUSGROVE, RONALD O., Schenectady
PRADILLA, MICHAEL, Jackson Heights
STIRN, FRANK E., Pearl River
VITALE, BENEDICT F., Auburn
WARRICK, ROBERT V., New York

North Carolina

BUZZARD, GALE H., 2ND, Durham
•SIMPSON, WILLIAM M., Charlotte

Ohio

BARRICK, JAMES E., Alliance
•BOSCH, ANTHONY A., JR., Toledo
BROWN, GERALD H., Worthington
CLARK, JOHN E., Lancaster
•DEPWEG, FRANK A., Hamilton
•DODSON, CHARLES W., Cincinnati
HUNTER, THOMAS A., 3RD, Cleveland
MCCLAIN, JOHN R., Granville
MINTON, CARL H., Warren
STEPHENS, GERALD L., Cincinnati
STEVENSON, KENNETH W., Mt. Vernon

Oklahoma

BORN, JOHN W., Tulsa
JENKINS, CECIL, Tulsa
WILDER, LAWRENCE B., Tulsa
WOOLSLAYER, HOMER J., Tulsa

Oregon

WINGROVE, WILLIAM C., Portland

Pennsylvania

ANTHONY, FREDERICK, Lester
EKLUND, PHILLIP R., Pittsburgh
EUWER, HERBERT D., Berwick
JOHNSON, ERLE E., Wilkinsburg
LORD, JOHN P., Bradford
MULLIKEN, HARRY B., Pittsburgh
NOGGLE, LUKE H., JR., Pittsburgh
SCHALLER, PHILIP H., Fort Washington
SCHWARTZ, ELMER G., Pittsburgh
STUBENBORT, JOSEPH W., JR., Pittsburgh

Rhode Island

COFFMAN, PAUL A., JR., Providence
STEERE, ROBERT E., JR., Chepachet

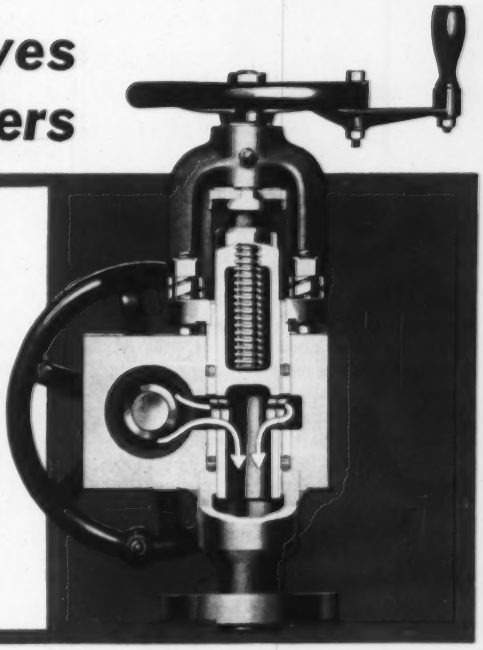
South Carolina

ALLEN, ROLAND L., JR., Greenville

(ASME News continued on Page 148)

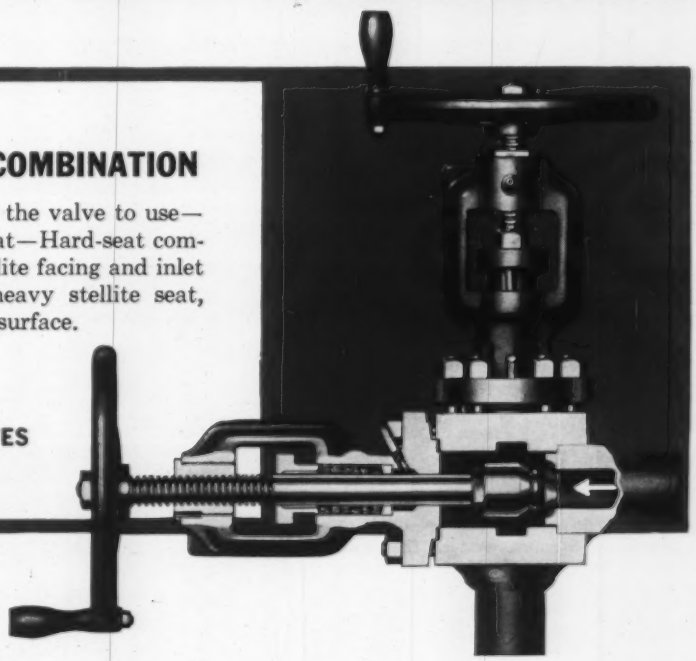
UNIT TANDEM

rugged blow-off valves for high pressure boilers



HARD-SEAT—SEATLESS COMBINATION

■ For boilers up to 1500 psi, this Yarway Unit Tandem Blow-Off Valve offers the maximum in dependable service. A one-piece forged steel block serves as the common body for the Yarway Stellite Hard-seat blowing valve and the Yarway Seatless sealing valve. All interconnecting flanges, bolts and gaskets are eliminated. The Unit Tandem at right is sectioned through Seatless Valve to show balanced sliding plunger in open position and free flow.



HARD-SEAT—HARD-SEAT COMBINATION

■ For boilers to 2500 psi, this is the valve to use—Yarway's Unit Tandem Hard-seat—Hard-seat combination. Disc has welded-in stellite facing and inlet nozzle has integral welded-in heavy stellite seat, providing smooth, hard-wearing surface.

OVER 4 OUT OF 5
HIGH PRESSURE PLANTS
USE YARWAY BLOW-OFF VALVES

Write for Yarway Catalog B-434

YARNALL-WARING COMPANY
108 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY **BLOW-OFF VALVES**

MITCHELL, ROBERT B., Spartanburg

Tennessee

BAILEY, REX, Memphis

Texas

●BROOMAS, MICHAEL S., Baytown
DAVIS, PHILIP E., JR., Houston
GRAVES, ROBERT W., Lake Jackson
JAMES, GORDON, Houston
KELSO, HARRY B., Texas City
KOCH, WILLIAM M., Houston
O'RIORDAN, DESMOND, Houston
●SHANNON, RAY, Beaumont
STORK, WALTER J., JR., Dallas
●WILLIAMS, THOMAS F., JR., Houston

Washington

MARSHALL, FRANK W., Seattle
●MCCLAIN, FRANK G., Tacoma

West Virginia

BICKEL, WILLIAM F., Dunbar
GILLIS, SIDNEY H., Charleston
●MITCHELL, JOHN W., Charleston
WOODACRE, ERNEST E., Parkersburg

Wisconsin

HESKESTAD, GUNNAR, Milwaukee
HOCHSTRASSER, WERNER H., La Crosse
●KING, BOB W., W. Milwaukee
PAVELIC, VJEKOSLAV, West Allis
RAYNOHA, JOHN E., Fond du Lac
SELBREDE, ROBERT H., West Salem

Foreign

ALVES, ARTUR D., Lisbon, Portugal
ANTIA, JAL M., Bombay, India
CHAMBERLAIN, HENRY, Claxton Bay, Trinidad
CZERNECKI, RUDOLF, Toronto, Ont., Canada
DE RO, RAYMOND V., Goose Bay, Lab., Canada
HILLS, AUSTIN A., Leaside, Ont., Canada
●KOHLOSS, FREDERICK H., Kailua, T. H.
●LEITH, WILLIAM C., Montreal, Que., Canada
MERRIMAN, HORACE B., London, England
NATU, K. V., Bombay, India
SOOD, BHARAT B., Punjab, India
VAN LIEROP, BERYL, Buenos Aires, Argentina

A Tribute to . . .

Marjorie Roy Rothermel

1905–1957

MARJORIE ROY ROTHERMEL was born July 2, 1905, in the southwestern Wisconsin town of Shullsburg and passed away in New York City on Nov. 13, 1957, after a six weeks' illness. At the time of her death she was President of the Woman's Auxiliary to the ASME.

She was graduated from high school as valedictorian in 1923, followed by a year of study of the drama in Chicago after which she was matriculated at the University of Wisconsin School of Journalism. On Valentine's Day, 1926, she met Ulla Amel Rothermel, then a student of engineering at the university. On June 16, 1928, one year after Mr. Rothermel's graduation, the couple were married at the Centenary Methodist Church in Shullsburg. Twenty-nine years and five months later the same minister in the same church officiated at her final funeral services preceding interment in the family plot near the ancient trees of Evergreen Cemetery.

After living in Fort Wayne, Ind., for several years, and eight years in Milwaukee, Wis., the couple came to New York City in 1941 where they lived at 220 Madison Avenue where Mr. Rothermel and Mrs. Maud Roy, Mrs. Rothermel's mother, still reside. Mr. Rothermel's activity as a sales engineer created many travel opportunities throughout most of the East and Mrs. Rothermel always accompanied him. Vacations were utilized for travel to such places as Europe, the Caribbean, Mexico, and just last summer, en route to and from the ASME Semi-Annual Meeting in San Francisco, the Rothermels visited all the Woman's Auxiliary Sections west of the Mississippi, including the Hawaiian Section. Mrs. Rothermel, as National President of the Woman's Auxiliary, along with William F. Ryan, President of ASME, was presented with many honors, not only in Honolulu but in the out-islands they visited.

Mrs. Rothermel started her activities in the Woman's Auxiliary as program chairman of the Metropolitan Section, followed by chairmanship of the Metropolitan Section for two years, several years concurrently in vice-presidential offices of the National Board, culminating in her election as National President at the 1956 Annual Meeting in New York, to which she was re-elected posthumously by ballot preceding the 1957 Annual Meeting. At the time of her election the Auxiliary was 33 years old and had 21 sections. Her goal for the thirty-fifth anniversary year was 35 sections. At the time of her death there were 27 sections, nearly half of the goal having been achieved in less than a year. She was also instrumental in initiating a third Scholarship Fund in the Auxiliary for American graduate students in mechanical engineering. At the 1957 Annual Meeting the Auxiliary did her memory the great honor of naming the new fund the "Marjorie Roy Rothermel Scholarship Fund."

Her many friends in the East paid their last respects at an impressive funeral service in Marble Collegiate Church in New York with Dr. Norman Vincent Peale officiating and with the vocal selections, "Crossing the Bar" and "Autumn Leaves," by Chester Watson, Metropolitan opera baritone.

Up to the day of her death she was actively discussing and considering plans for the Woman's Auxiliary and for the Women's Guild of Marble Collegiate Church of which she was also president at the time of her death. She was also First Vice-Regent of the Manhattan Chapter of the Daughters of the American Revolution. Her deep religious philosophy of being in God's hands at all times was an inspiration to all her friends and must have contributed to the peaceful and painless hours during which she courageously passed from the activities of this world to those of the next. The Woman's Auxiliary has lost a dedicated and brilliant leader who sacrificed rest or pleasure in order to promote the objectives of the Woman's Auxiliary to the ASME.

Mrs. U. A. Rothermel, who at the time of her death on Nov. 13, 1957, was President of the Woman's Auxiliary to the ASME

OBITUARIES

Weldon Henry Brandt (1910–1957), director, Sunnyvale Manufacturing Division, Westinghouse Electric Corp., Saratoga, Calif., died Sept. 17, 1957. Born, Pearl City, Ill., Feb. 20, 1910. Parents, William H. and Hattie F. Brandt. Education, BA, North Central College, 1931; MS, University of Illinois, 1933; PhD, 1936. Married Mary L. Bennett, 1934. Mem. ASME, 1948. Mr. Brandt began his association with the Westinghouse Corp. and its affiliates in 1938, and successively held positions as research engineer, section engineer, assistant manager, manager, and director. As an ASME Lecturer for the year 1956-1957, Mr. Brandt delivered his talk on "Automation in the U.S.S.R." to 18 ASME Sections throughout the country. He was the author of many articles published in the technical press. Member Sigma Xi. Survived by his widow; a son, Gerald Bennett Brandt, Cambridge, Mass.; and a daughter, Margaret Jean Brandt.

J. Ansel Brooks (1876–1957), professor emeritus, Newark College of Engineering, Newark, N. J., died Nov. 13, 1957. Born, Worcester, Mass., April 7, 1876. Parents, James Weston and Sarah (Platt) Brooks. Education, PhB, Yale University, 1898; ME, 1902. Married Laura Stevens, 1912. Assoc-Mem. ASME, 1907; Mem. ASME, 1911. During World War I, Mr. Brooks served as a captain in the U. S. Army Air Service. He was a past-president of the Providence Engineering Society and of his local Sigma Xi chapter. He served the Society on the Committee on Awards. Survived by his widow.

Clayton Raymond Burt (1874–1957), former president, Niles-Bement-Pond Co., now known as the Pratt & Whitney Co., died Oct. 21, 1957, West Hartford, Conn. Born, Lynn, Mass., Dec.

(ASME News continued on page 150)

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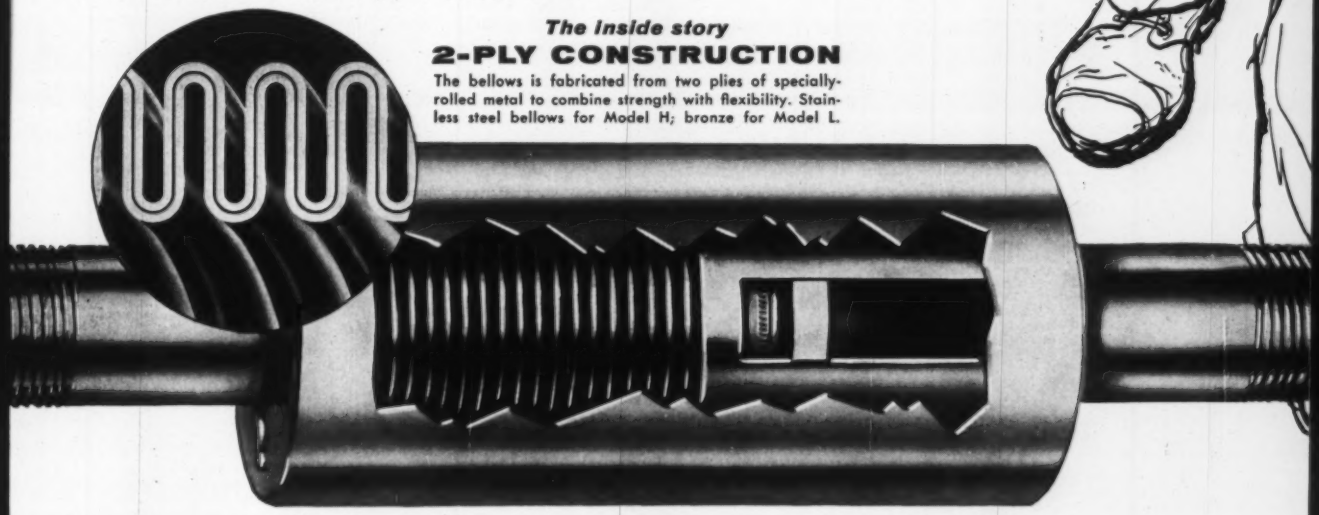

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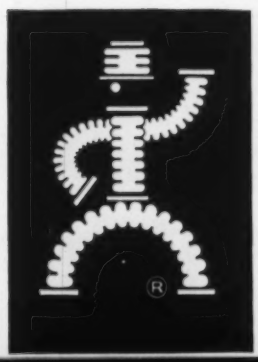

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BELLOWS

AIRCRAFT COMPONENTS

17, 1874. Education, high-school graduate. Married Charlotte Wells. Mem. ASME, 1909. He was president of the National Machine Tool Builders Association, 1936–1937. Mr. Burt had been a past-president of the Potter & Johnson Co., Pawtucket, R. I., a subsidiary of Niles. He was a trustee of the Hartford-Connecticut Trust Co., the West Hartford Trust Co., a former president of the Manufacturers Association of Hartford County, and of the Hartford Chamber of Commerce. Survived by his widow, Charlotte Wells Burt.

Charles Wearne Conrad (1887–1957), president, Conrad & Son, Inc., East Walpole, Mass., died Oct. 24, 1957. Born, Fenimore, Wis., May 28, 1887. Parents, Anthony Lee and Anne (Wearne) Conrad. Education, EE, University of Texas, 1909. Married Flora Deyo Tandy, 1913. Mem. ASME, 1921. Mr. Conrad built and managed the first Canadian Texas Electric Light and Power Plant, served on the Chicago Smoke Abatement Committee, and was plant engineer at Eddystone Rifle Works, Eddystone, Pa. During World War I, he was plant engineer, superintendent, vice-president, and director of manufacturing for Bird & Son, Inc., East Walpole, Mass. Mr. Conrad played a major role in the electrification of industry, he led in the design of insulating board, roofing, felt and paper-board mills, in addition to modifying and rebuilding existing plants and mills. Survived by his widow; and his sons, Charles T. Conrad and Anthony L. Conrad, Moorestown, N. J.

Eugene Hector Fezandie (1897–1957), professor of mechanical engineering, Stevens Institute of Technology and a partner in the consulting engineering firm of Greygang, Fezandie & Moser, died Nov. 10, 1957. Born, New York, N. Y., Dec. 31, 1897. Parents, Joseph Hector and Margaret Ann (Phillips) Fezandie. Education, BS, Columbia University, 1917; ME, 1922. Married Eleanor Doty, 1923. Jun. ASME, 1922; Assoc. Mem. ASME, 1926; Mem. ASME, 1930. Since 1923, Mr. Fezandie had been on the faculty of Stevens where he taught thermodynamics, heat power, fuel testing, and air conditioning. Mr. Fezandie, from 1937–1940, served as a member of the Executive Committee of the Metropolitan Section, ASME. Member Sigma Xi. Survived by his widow, Eleanor Fezandie; and three daughters, Mrs. William Goodwin, Mrs. Walter Ballinger, and Miss Pamela B. Fezandie.

Charles A. Gill (1884–1957), railroad executive and transportation consultant who since 1948 had traveled extensively in the Far East, died May 18, 1957. Born, Buffalo, N. Y., Jan. 19, 1884. Parents, Zachery Taylor and Mary (Hurley) Gill. Education, public schools of Baltimore, Md. Married Magdalene Lauer. Mem. ASME, 1921. Mr. Gill had been superintendent of motive power and rolling equipment for the Reading Company and was associated with the Baltimore & Ohio Railroad in various capacities from 1896. The Soviet government appointed him chief consulting engineer for the railroad systems of Russia for one year. Member Newcomen Society.

Edward F. Kelley (1895–1957), designer, Oil Division, The M. W. Kellogg Co., New York, N. Y., died Oct. 28, 1957. Born, Somerville, Mass., April 24, 1895. Education, high-school graduate, attended Lowell Institute. Mem. ASME, 1930. Mr. Kelley had been a specialist in the design of derricks and rig machinery. Survived by his sister, Mrs. Ernest Burrowes, Arlington, Mass.

Dexter Simpson Kimball, Jr. (1906–1957), general manager, Bendix-Westinghouse Automotive Air Brake Manufacturing Co., Elyria, Ohio, died April 28, 1957. Born, Ithaca, N. Y., July 15, 1906. Parents, Dexter Simpson, past-president and Hon. Mem. ASME, and Clara Evelyn Kimball. Education, ME, Cornell University, 1927; MME, 1928. Married Myrtle Pullen, 1936; two sons, Dexter S., 3rd, and James W. Kimball. Assoc. Mem. ASME, 1928; Mem. ASME, 1939. Mr. Kimball had been associated with Bendix-Westinghouse since 1945. For a period, he had been an assistant professor of industrial engineering at the Cornell University school of engineering. He was coauthor of the last edition of "Kimball's Principals of Industrial Organization." He had also been a contributor to ICS courses.

Robert Talbot Knapp (1899–1957), professor of hydraulic engineering at the California Institute of Technology, Pasadena, Calif., and an active member of the engineering profession in research and in academic circles, died Nov. 7, 1957. Born, Loveland, Ohio, Jan. 5, 1899. Parents, Herman and Almira S. (Talbot) Knapp. Education, BS(ME), Massachusetts Institute of Technology, 1920; PhD, California Institute of Technology, 1929. Married Pearl M. Gilliland, 1925. Assoc. Mem. ASME, 1921; Mem. ASME, 1947. Professor Knapp's main energies were devoted to research in the general field of hydraulics. His interests ranged over practically the entire field, including hydraulic machinery, cavitation, underwater ballistics, and general hydrodynamics, sediment transportation, high-velocity flow in open channels, and wave and harbor problems. Although he made significant contributions to each of these subjects, he was best known to mechanical engineers for his work in pumps and cavitation. His investigations of pumps for the Colorado River Aqueduct established new standards in measurement of different parameters, and led to establishing more critical specifications for bidding, which resulted in appreciably higher efficiencies than expected. One important consequence of this work was that all major pump manufacturers modified their laboratories to approximate the standards set by Dr. Knapp. His cavitation studies cleared up many obscure points in its mechanics, not only for simple bodies but also for machinery. His latest efforts in this field dealt with the very important practical problem of cavitation damage. Dr. Knapp had worked on numerous wartime and postwar projects for the Army, Navy, and the Bureau of Ordnance. These include an emergency study for the U. S. Navy to aid in maintaining an antisubmarine net in the Golden Gate, and investigations on hydrodynamic and ballistic problems involved in air and water trajectories of rockets, bombs, torpedoes, and so on. He was also director of model studies for the Bureau of Yards and Docks of the U. S. Navy, investigating hydrodynamics and wave and surge problems. He served the Society as a member of the Executive Committee, Hydraulic Division, 1946 to 1951, serving as secretary in 1950, and chairman in 1951. He was a chairman of the Cavitation Committee from 1948 to 1956. In 1929, he traveled in Europe as ASME Freeman Fellow; in 1952, he delivered the James Clayton Lecture on the subject of cavitation to the Institution of Mechanical Engineers in London. He was ASME National Lecturer on cavitation from 1953 to 1955; and in 1955 he was awarded the ASME Melville Medal for his paper, "Recent Investigations of the Mechanics of Cavitation and Cavitation Damage." He was a member also of the ASCE, the American Geophysical Union, Sigma Xi, and Tau Beta Pi; and a Fellow of the American Physical Society. Survived by his widow.

Joseph Leonard Kopf (1891–1957), treasurer of the Society, and president, Jabez Burns and Sons, Inc., New York, N. Y., died on Oct. 21, 1957, at a meeting of the ASME in Skytop, Pa., at which he was to receive the certificate of his promotion to Fellow ASME. Born, Newark, N. J., March 26, 1891. Parents, Charles and Josephine Kopf. Education, BS(ME), Cooper Union, 1917; postgraduate study, Brooklyn Polytechnic Institute. Married Anna R. Ellis, 1917. Assoc. Mem. ASME, 1931; Mem. ASME, 1935; Fellow ASME 1957. Under Mr. Kopf's guidance, many outstanding contributions to the technical development of industrial machinery for roasting and other processing of coffee, peanuts, and cocoa beans were made. These include the development of the Thermalo roasting principle, which is now in standard use in the coffee trade, development of continuous roasting, and changes in equipment which make possible the smokeless operation of coffee roasters. He held several patents for coffee-brewing equipment and processes. He was noted not only for technical advances in food-processing equipment, but also for advanced practices in the field of industrial relations. From 1950 to 1952, Mr. Kopf was president of the National Metal Trades Association; prior to that he had served as national treasurer and as vice-president of the NMTA and as president of the New York-New Jersey Branch of that organization. Mr. Kopf was also active in the Society for the Advancement of Management, the United Engineering Trustees, and the American Management Association. He was noted not only for technical advances in food-processing equipment but also for advanced practices in the field of industrial relations. Under Mr. Kopf's leadership, Jabez Burns & Sons, Inc. was one of the first companies in the country to utilize the NMTA Job Rating, Salary Rating, and Merit Rating plans for equitable treatment of employees. He also made Burns a pioneer company in assisting and encouraging employees to undertake programs of self-improvement and education. The industrial safety programs encouraged by Mr. Kopf at Burns have been regularly cited by the National Safety Council. Also under his leadership, Jabez Burns & Sons was one of the first companies to give fully company-paid hospitalization, medical, and surgical benefits to all employees. Survived by his widow; three daughters, Mrs. James Popelka, Morris Plains, N.J.; Joan Kopf, Teaneck, N. J.; and Sister Mary Aquinas of Good Shepard Convent, Peekskill, N. Y.; and a son, J. Ellis Kopf; and a sister, Mrs. Karl Schmidt, Short Hills, N. J. He had seven grandchildren.

Bert Lampe (1931–1957?), formerly junior test engineer, Turbine Engine Design Division, Wright Aeronautical Corp., Wood-Ridge, N. J., died recently. Born, New York, N. Y., Dec. 4, 1931. Education, BS(ME), The College of the City of New York, 1955. Assoc. Mem. ASME, 1955. Mr. Lampe was serving in the U. S. Army at the time of his death.

Stillson Freeman Lawrence (1899–1957), mechanical engineer, structural department, The Lummus Co., New York, N. Y., died Nov. 15, 1957. Born, Trenton, N. J., Feb. 12, 1899. Parents, Wilder Freeman and Gertrude Ann (Stillson) Lawrence. Education, BS(ME), Stevens Institute of Technology, 1921. Married Dorothy Flemming Bell. Jun. ASME, 1923; Assoc. Mem. ASME, 1933; Mem. ASME, 1935. A registered engineer in the State of New York, Mr. Lawrence was active in the Eighth Assembly District South Republican Club. Survived by his widow; and a son, Stillson Freeman Lawrence, Jr.

Simon MacKay (1867–1957?), whose death recently was made known to the Society, had been vice-president in charge of manufacturing and maintenance, Union Twist Drill Co., Athol, Mass. Born, Lorne, Pictou County, Nova Scotia, Nov. 6, 1867. Parents, James and Annie (MacGregor) MacKay. Education, common schools. Naturalized U. S. citizen, New Bedford, Mass., 1905. Married Mabel T. Shurtleff; four children, Margaret A., Thornton W., Jean, and Richmond C. MacKay. Mr. MacKay had been associated with the Union Twist Drill Co. since 1905. He served also as a director of The First National Bank of Athol.

Harry McCarthy (1878–1957), retired, formerly assistant chief engineer, Walworth Co., Kewanee Works, Kewanee, Ill., died Jan. 16, 1957. Born, Moline, Ill., Feb. 2, 1878. Education, BS(ME), University of Illinois, 1902. Mem. ASME, 1909. Survived by a daughter, Harriet McCarthy.

Gilbert Rathman (1889–1957), designer and developer of revolutionary type of blower to increase the cruising range of atomic-powered submarines, Union, N. J., died Nov. 11, 1957. Born, Baltimore, Md., Feb. 20, 1889. Education, Baltimore public schools. Mem. ASME, 1925. Mr. Rathman had been general manager and vice-president of the Quimby Pump Co., Newark, N. J. In 1943, he resigned to devote full time to the blower in the plant of the Roots-Connersville Blower Co., Connersville, Ind., a division of Dresser Industries, Inc. Survived by his widow, Alma Hunt Rathman, and a son, John G. Rathman.

Harold L. Schubert (1924–1957?), whose death recently was made known to the Society, had been employed by the Northern Indiana Public Service Co., Hammond, Ind. Born, Henderson, N. Y., Feb. 19, 1924. Education, BS(ME), Northwestern University, 1953. Assoc. Mem. ASME, 1953.

Amos Bowman Snavely (1893–1957), chief engineer, Hershey Chocolate Corp., Hershey, Pa., died Oct. 20, 1957. Born, Lancaster, Pa., Oct. 5, 1893. Parents, Rohrer and Emma S. (Bowman) Snavely. Education, BS(ME), Pennsylvania State University, 1915; ME, 1920. Married Mary Elizabeth Mylin, 1919. Jun. ASME, 1916; Assoc. Mem. ASME, 1921; Mem. ASME, 1926; Fellow ASME, 1942. Mr. Snavely had been associated with the Hershey Chocolate Corp. since 1915, with the exception of the period during World War I, when he served as a second lieutenant in the Coast Artillery Corps. Mr. Snavely has long been recognized for his original work in the design and construction of food-processing machinery. Survived by his widow; and two sons, Clyde Mylin and Richard Bowman Snavely.

Walter George Stephan (1877–1957), president, Stephan Co., Cleveland, Ohio, died Oct. 23, 1957. Born, Cleveland, Ohio, Aug. 26, 1877. Parents, John and Wilhelmina Henrietta (Puls) Stephan. Education, BS(ME), Case School of Applied Science, 1899; ME, 1907. Married May Storer, 1907 (deceased 1934); children, James Wilbur Stephan and Mrs. Edmund Ingersoll. Married 2nd, Winifred Storer, 1937. Mem. ASME, 1920. Mr. Stephan held a patent for a self-weighing crane hook. He was the author of several books which range in subject matter from ore-handling equipment, to occasional poems, to the "Case Song Book." Mr. Stephan was a member of the Cleveland Heights Civil Service Commission for 33 years and had served as its president. In 1954, he received an award for meritorious service from the Case Alumni Association. He was a former president also of the board of trustees of the First Unitarian Church of Cleveland, and served as church historian. Survived by his wife, Mildred M. Green Stephan; his son and daughter; and two step daughters, Mrs. Nancy G. Giesey and Mrs. Betsy G. Webster.

William Alan Wilson (1913–1957), professor of mechanical engineering, Massachusetts Institute of Technology, Cambridge, Mass., died Nov. 2, 1957. Born, Richland Center, Wis., May 24, 1913. Education, attended Princeton University; BS(ME), Columbia University, 1934. Married Eleanor Lawson; four children, Carol L., Kathryn H., Grant M., and Douglas J. Wilson. His 15-year association with research and development in industry began in 1934 with an appointment as experimental engineer, Westinghouse Electric Corp. During and after World War II, he was a development engineer and mechanical division engineer in charge of gas-turbine developments at the Elliott Co. He joined the M.I.T. faculty in 1949 as associate professor and was promoted to a full professor in 1957. Mr. Wilson was the author of several papers published in technical journals, and held a patent for a self-priming viscosity pump. Survived by his widow and children.

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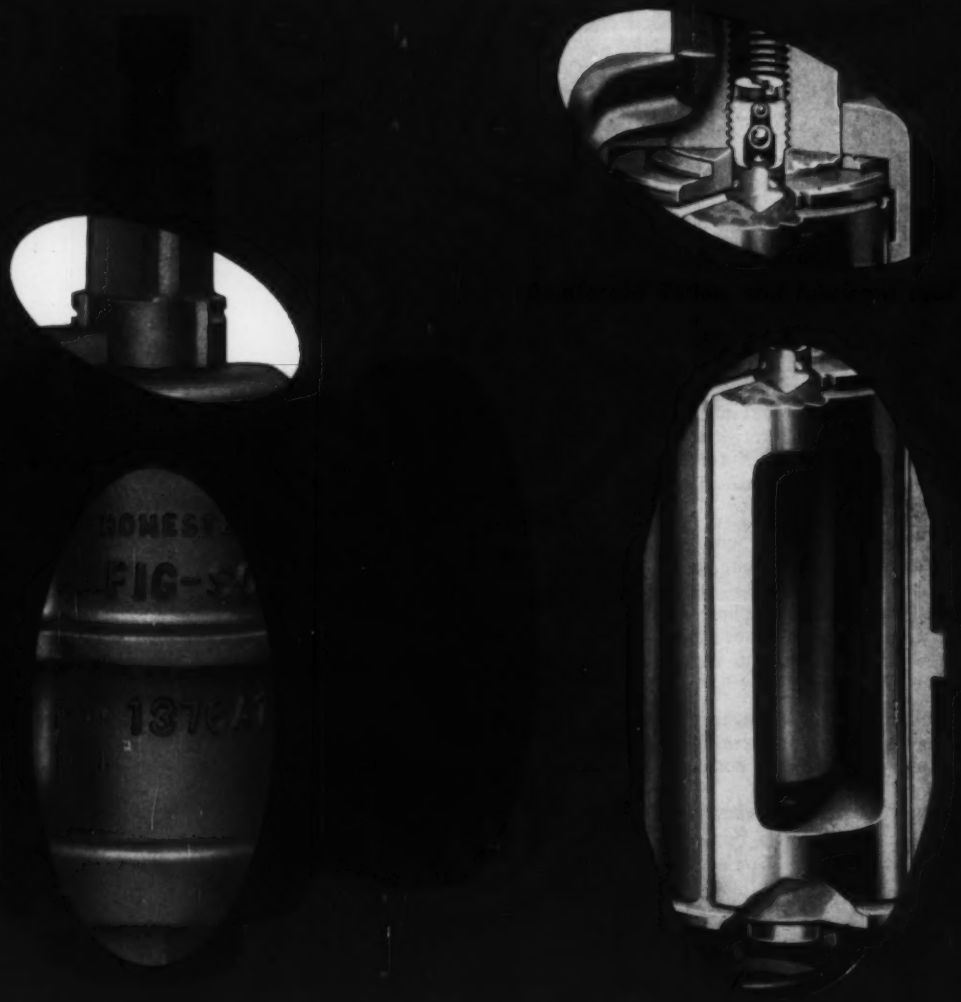

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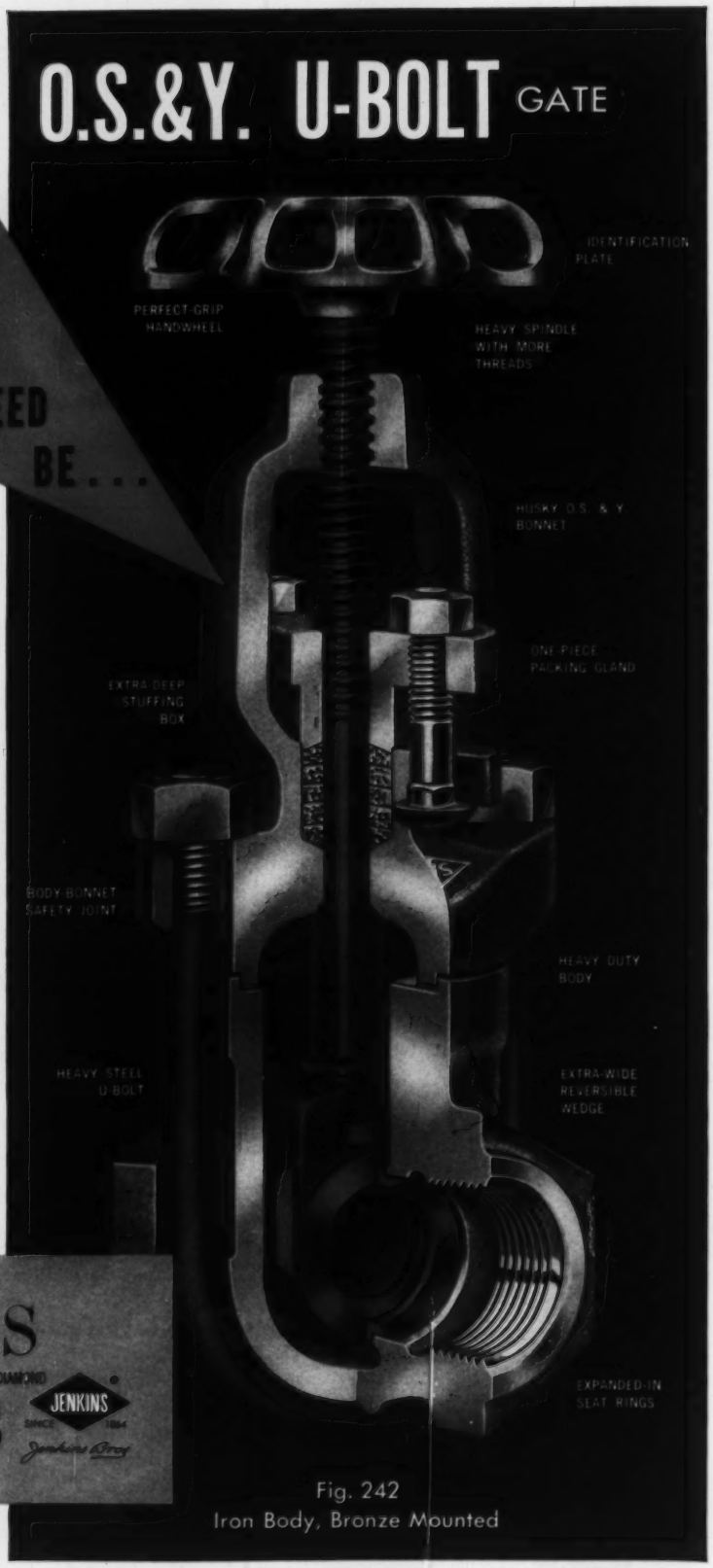

Fig. 242
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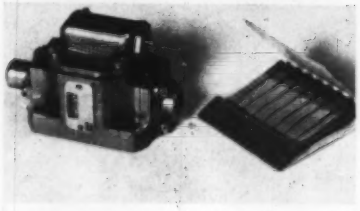


Dry Coil Servo Valve

A new dry coil, two-stage electro-hydraulic servo valve which is said to be 20 per cent lighter and more compact than other servo valves of similar capacity, has been announced by Vickers Inc.

The company reports that the valve was designed primarily for aircraft and missile applications requiring hydraulic flow proportional to small electrical input signals.

The valve is said by the firm to be desirable for porting modulated flow to an actuator in a flight control system or to a hydraulic motor for modulated rotary output motion with respect to input current. Among the features reported by the company is the first stage packaged subassembly consisting of torque motor, flapper, jets and barrier. This arrangement is said to provide greater flexibility through the use of various second stage components. Packaged construction also provides field service advantages, the firm states. —K-1

Positioning Device

A positioning device said to be particularly adapted for setting directionally sensitive flow probes in fluid streams where both depth of immersion and angle of rotation must be measured has been announced by Aerotech Specialties, Inc., Glastonbury, Conn.

Collets and pressure seals can be provided for sizes from $\frac{1}{8}$ to $\frac{1}{2}$ in. Immersion depth can be measured to 0.01 in. with a vernier and rotation to 0.2° with a rotatable vernier scale.

All scales have white lines on black surfaces with a minimum spacing of 0.05 in. for visibility in poor lighting. Friction loaded and positive stops simplify making the settings, the company says. —K-2

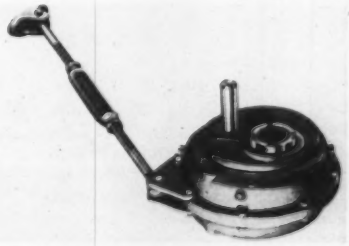
Spiral Pointed Tap

Beloit Tool Corp., announces development of a continuous spiral point tap with multiple chamfer sections which, the company claims, represents the first major improvement in tap design in 25 years.

Unlike standard spiral point taps, it forces the lubricant to the cutting edge and thereby extends the life of the tap, the firm says. The new design also pushes the chips ahead ot the tap to eliminate clogging of the flutes.

The unit, called Regal Jet tap, is available with single or multiple chamfer sections so that an entirely new cutting section including the proper chamfer and spiral point grind may be obtained without the necessity for resharpening equipment or replacing with a new tap, the company reports.

The tap is available in machine screw sizes 6, 8, and 10 for shallow hole depth threading, in high speed steel and with nitrite and chrome plating. —K-3



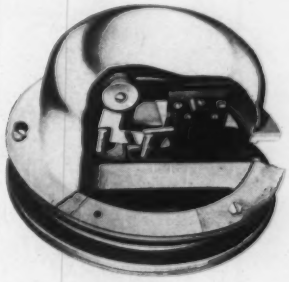
Shaft Gear Reducer

A shaft mounted gear reducer said to eliminate need for motor bases, rails, supporting structures, and flexible couplings is announced by Lovejoy Flexible Coupling Co.

The reducer is designed to eliminate alignment problems and make possible infinite speed ratios through the use of variable speed pulleys or by changing sheaves, sprockets or prime mover speed.

Proper belt tension between drive and driven unit is maintained by simple adjustment of the rod and turnbuckle, the company reports.

Eighteen models, including single and double reduction types, can be supplied from stock. Single reduction types are 98 per cent efficient and afford 4.5:1 speed ratio (nominal). Double reduction types are 96 per cent efficient and afford 14.7:1 speed ratio (nominal). Horsepowers range from fractional to 120, output speeds from 8 to 425 rpm. —K-4



Bin Indicator, Control

Improvements in the Bin-Dicator, an automatic bin level indicator and control unit, are announced by Bin-Dicator Co.

The firm says the most significant change, designed to be helpful on units which are to be installed in hard-to-get-at locations, is a twist lock cover. This new design has no nuts or bolts which can drop. It incorporates slotted hex head screws which need only to be loosened so that the cover can be turned and lifted, exposing the entire operating mechanism, the company reports.

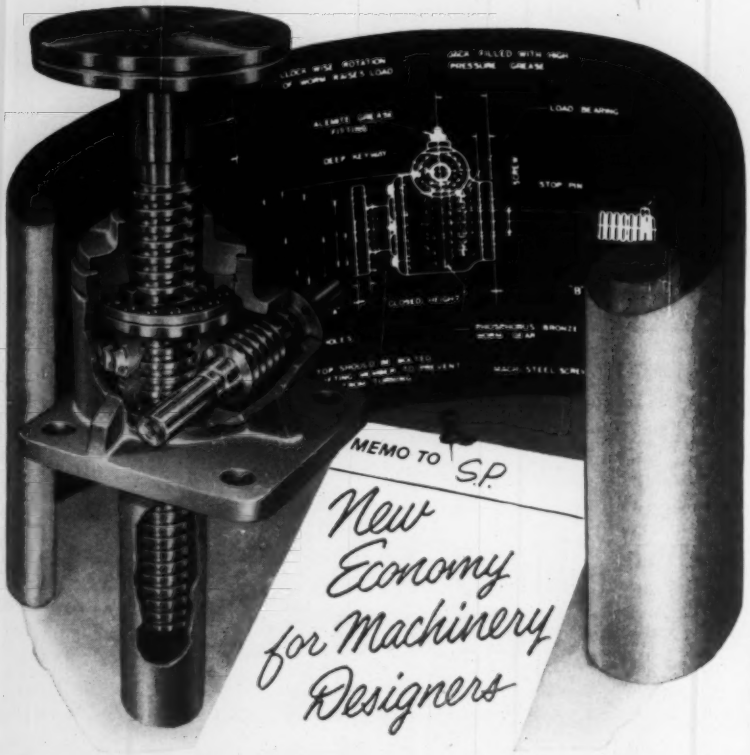
Another improvement is a vented housing, designed to permit a more sensitive and reliable operation. This vent relieves any pressure build-up in the housing as the diaphragm is flexed in response to the pressure of the material in the bin, silo, hopper or chute.

Other new construction features include a drilled and tapped frame for assembly of cover, drilled and tapped frame for assembly of diaphragm and diaphragm retainer ring, and a diaphragm assembly which has perforated mounting holes to simplify replacement and/or change of diaphragm. —K-5

Heat Exchanger Coils

Niagara Blower Co. announces the manufacture of coils in aluminum, copper, stainless, carbon and alloy steels and hot-dipped galvanized steel for various heat exchange duties in process industries.

The coils are manufactured in both prime surface and extended surface types. Coil types include series flow, serpentine coils, parallel flow coils with special headers, fully cleanable coils, variously partitioned coils, and coils with bends to various radii. Coils for pressures up to 3000 lb are also available. —K-6



NOW, A STANDARD LINE OF DUFF-NORTON WORM GEAR JACKS

The economies of standardized production now can be realized by machinery designers who use Duff-Norton worm gear jacks for accurate positioning of loads weighing as much as several hundred tons. After 25 years of experience and hundreds of custom designs, Duff-Norton engineers have produced a standard line of eight jacks ranging from 2 to 100 tons in capacity which will meet almost any requirements. When jacks are used in an arrangement, added economy can be realized in raising unevenly distributed loads, since all models now have a uniform raise which permits jacks of varying capacities to operate in unison.

Worm gear jacks are purely mechanical devices, and they can hold heavy loads in position indefinitely without any creep. Functioning as components of machinery or equipment, they can raise or lower loads, apply pressure or resist impact. Worm gear jacks can be furnished with raises up to 24 inches, and they will provide exactly the same raise for years without adjustment.

Thousands of these jacks are in use on feeding tables, tube mills, welding positioners, pipe cut-off and threading machines, testing equipment, aircraft jigs, loading platforms, rolling mills, conveyor lines, and numerous other types of equipment. If you have a positioning problem, write for complete information, requesting Bulletin AD-66-FF, which includes drawings and full specifications.

DUFF-NORTON COMPANY

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Hydraulic, Worm Gear

DUFF-NORTON

COFFING HOISTS
Ratchet Lever
Spur Gear, Electric

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LATEST CATALOGS

Anti-Siphon Vacuum Breakers

A. W. Cash Valve Mfg. Corp. announces a line of anti-siphon vacuum breakers, designated Type VB series, designed to prevent polluted water from siphoning back in the potable supply lines in installations where the supply enters an appliance or fixture below the overflow rim.

The company states the valves are of bronze construction, and are available in pipe sizes from $^3/_8$ to 2 in. The valve is equipped with a specially compounded composition poppet assembly which has a specific gravity of less than 1, the company reports. It is designed to operate under maximum water pressure of 125 lb and maximum temperature of 150 F. —K-7

Ductile Iron Steam Traps

A new line of ductile iron steam traps claimed to cost less than half as much as comparable cast steel traps has been announced by Strong Steam Specialties Div., Strong, Carlisle & Hammond.

They are designated 540 series Hydro-Flex traps, and are designed for service to 500 psi and 650 F.

According to the company, ductile (nodular) iron, a recent metallurgical development will bend or twist without breaking under fire or explosion. Its strength, toughness and wear resistance is said to be comparable to steel. Ductile iron can be welded or brazed. ASME has adopted it for use in vessels at pressures to 1000 psi and temperatures to 650 F.

The firm states that inverted bucket design of the traps incorporates a dual-fulcrum action of the valve lever which provides high discharge flow when required, yet permits efficient handling of very low condensate loads. All internal parts are made of heavy stainless steel. The bucket is deep-drawn with no seams or joints.

The traps are available in five standard sizes with pipe connections from $^1/_2$ to 2 in., screwed or socket weld, and discharge capacities to 42,800 lb of water per hour. —K-8

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

End Face Seals

A new line of end face seals in standard sizes is now being offered by Chicago Rawhide Mfg. Co., Chicago.

Pre-engineered to meet the widest possible range of sealing requirements, the new seals are available in two complete series, long and short. Specifications include 3/4 to 4-in. shaft sizes; pressures to 500 psi; temperatures to 500 F; and peripheral speeds to 15,000 fpm. —K-9

Reinforced Steam Hose

Wire-braid reinforced, burst-proof hose for saturated steam service at pressures up to 200 psi, or for superheated steam up to 385 F is announced by Acme Rubber Mfg. Co. Div., Acme-Hamilton Mfg. Corp., 115 Meade St., Trenton 3, N.J.

The hose, designated Acme WB is built around a tube compounded of special heat-resisting rubber. Reinforcement is provided by one or two braided plies of high-tensile steel wire, each covered by a layer of heat resistant rubber. High-tensile cord yarn covers the outer layer and aids in bonding the neoprene hose cover, the firm states. Standard sizes include 1/2, 3/4, 1, 1 1/4, 1 1/2, 2, and 2 1/2 in. ID. —K-10

Battery-Powered Hand Truck

Two models of a straddle-type stacker have been added to the Powrworker line of battery-powered hand trucks produced by the Industrial Truck Div., Clark Equipment Co.

Model 20 STF has 2000 lb capacity and Model 40 STF has 4000 lb capacity. Depending on which of seven sizes of uprights are specified, the unit can lift and tier palletized goods to a height of 94 to 130 in., the company reports.

A feature of the new unit, called Straddle Stacker, is an articulated drive unit. Mounted on a roller assembly, the drive unit will traverse up and down as much as three inches to compensate for uneven floor conditions, the firm states.

Forward and reverse direction is controlled by a butterfly switch in the control head on the steering handle. Electric switches are reported to make it impossible to direct both forward and reverse current to the drive motor at the same time. The steering handle turns 90 deg in each direction. Brakes are automatically applied when the steering handle is in either vertical or horizontal position, and the handle returns to vertical position when released by the operator. When the brake is applied the power circuit is broken automatically.

The machine will travel 2.8 mph empty and 2 mph loaded. Without battery, Model 20 STF weighs 2770 lb and Model 40 STF weighs 3190 lb. Fork lengths available are 30, 36, 42 and 48 in. —K-11

NEW...from WINSMITH SPEED REDUCERS

SHAFT MOUNTED WORM GEAR SPEED REDUCERS

SERIES "ST" Torque Arm Type

SERIES "SF" Flange Mounted Type

Now you can specify Winsmith performance, dependability and economy for applications requiring a shaft mounted speed reducer.

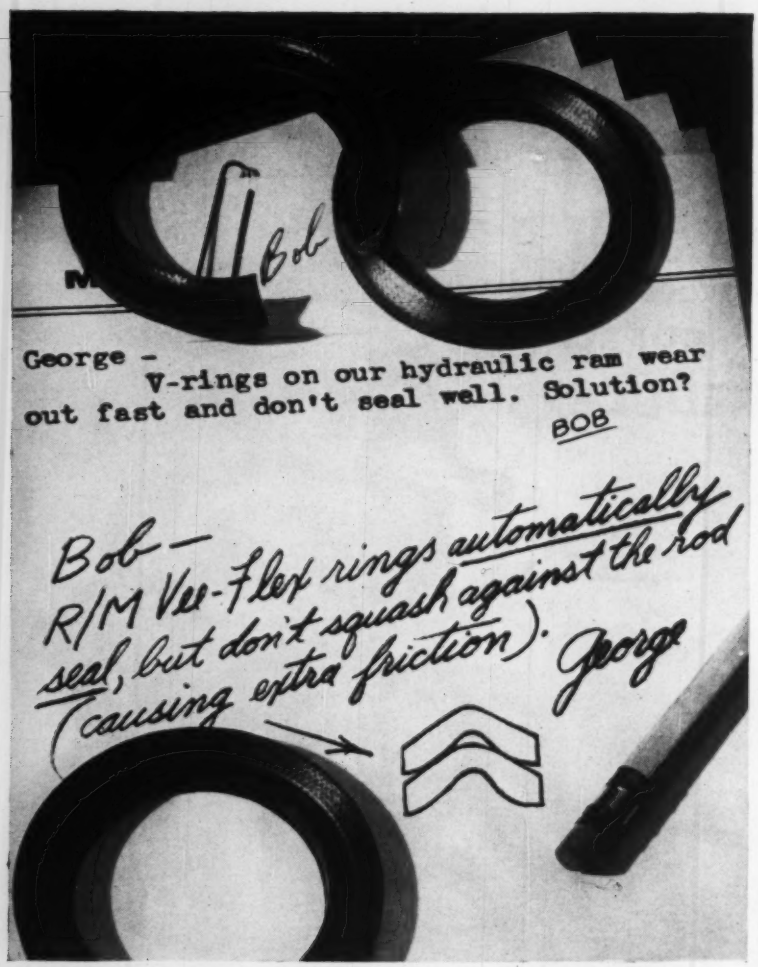
The new Winsmith "ST" and "SF" series require less space than conventional models because they eliminate the need for couplings and bed plates. Both series are currently available in three sizes . . . in ratios from 7 1/2:1 to 77:1 . . . horsepower from .63 to 8.82 . . . maximum output torque range from 816 to 7678 in. lbs.

These new shaft mounted models also embody all the advanced engineering and construction features that make Winsmith Speed Reducers first choice for any application from 1/100 to 85 h.p.

WRITE . . . FOR NEW CATALOG

For all the facts and complete technical data on Winsmith Shaft Mounted, Worm Gear Speed Reducers, write today — on your company letterhead, please — for Catalog No. SM-57.

WINSMITH, INC. 20 Eaton Street, Springville, (Erie County), N. Y.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V-rings on our hydraulic ram wear out fast and don't seal well. Solution?
BOB
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George

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Not only better design, but also better construction. Fabric is deeply penetrated by compound to provide longer, more dependable wear. Precision molding and trimming for the best possible fit and extra-long service life.

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Hot Water Generators

Cyclotherm Div., National-U.S. Radiator Corp. announces a line of packaged hot water generators designed to supply capacities from a range of 670 through 6700 mbh for standard forced circulation hot water systems.

Other models are available for high temperature operation or systems requiring larger capacities, the company reports. —K-12

Automatic Loading Device

Availability of a new automatic-loading device with automatic ejection for its universal rotary gear finishing machines is announced by Michigan Tool Co.

The device, designed for automated lines, can be used as original machine equipment or as a modification unit for the firm's 870-series finishers now in use.

Gears are automatically fed from a demand-type parts-distribution system, so the device can permit one operator to handle a battery of machines with ease, the company reports. Loading, shaving and unloading are automatic. The firm says the loading unit, although custom tailored to the application, is standardized for gears up to approximately 4-in. diam. It can be equipped with gaging gears at the entry end of the feed chute. These gears, the company says, prevent oversize parts, requiring excessive stock removal, from entering the loading slide.

In operation, gears roll down a gravity chute. A pneumatic cylinder-operated plunger then places a part into the loading shuttle. This pneumatically operated shuttle accepts only one gear at a time. It carries the gear to shaving position where the gear is picked up by air-operated centers or plug-type locators. The gear is then in mesh with the finishing cutter.

According to the company, the loading is foolproof, for if the part is not meshing properly with the cutter, a sensing device prevents the centers from entering the part. In this case the shuttle returns and repeats the loading operation until proper meshing takes place. Improper meshing of the part and cutter is said by the company to be a rare occurrence; the device merely insures against any possible damage or breakage to the finishing cutter. After finishing, the centers withdraw and the shuttle returns the gear to its out position. Here, a plunger operated by another limit switch-controlled pneumatic cylinder simultaneously moves the gear from the shuttle into the ejection chute and places the next gear into the shuttle.

The machine remains in automatic cycle—loading, finishing and ejecting—until the parts supply is exhausted, then the machine automatically stops. By means of a pre-set counter a signal light indicates at any desired number of gears finished when shaving cutter should be checked for need of sharpening. This latter feature is available as optional equipment, the firm reports.

—K-13

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Small Size Reductors

Three small size speed reducers for light-duty applications have been announced by Boston Gear Works.

Model R113 is a miter gear reductor with 1-1 ratio and a horizontal right angle drive. It weighs 3.75 lb and its rated output ranges from 0.3 to .333 hp.

The two other new reductors are worm gear assemblies. Model T109 is designed with the worm gear over, and Model U109 with the worm gear under. Ratios for both range from 5:1 to 30:1, and output from .03 to .08 hp. **—K–14**

Crystalline Tubing

Commercially available Pyroceram brand tubing has been announced by Corning Glass Wks.

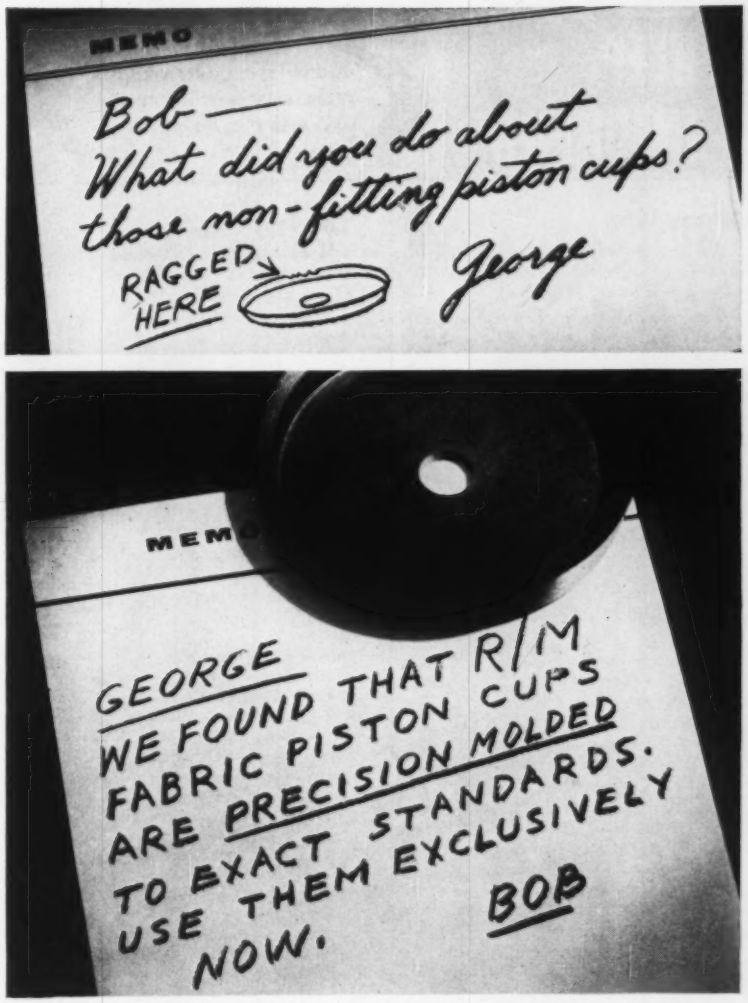
Tubing, in diameters ranging from $^1/_8$ to $^3/_4$ in. is available in quantity for such industrial applications as heat exchangers and process piping, the company states. The tubing is pure white and opaque, with the thermal shock resistance equivalent to that of fused silica.

Coefficient of expansion for this crystalline material is 5 to 11 $\times$ 10^{-7} cm/cm/degree C (compared with 32 $\times$ 10^{-7} for borosilicate glass). Flexural strength of abraded Pyroceram Code 9608 tubing is 17,000–23,000 psi. **—K–15**

Electric Motor Brake

Stearns Electric Corp. announces its Style HTC 50 series brake for use with fractional horsepower electric motors in frames 56-C and 66-C and in integral motor frames 182 and 184.

The brake is designed for use on stub, extended, or thru shaft applications. It has a single solenoid, lever action and unitized construction. Furnished as standard are cast iron housing and endplate, visual wear indication, and automatic manual release and reset. The brake is available for operation on all standard a-c voltages. **—K–16**



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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Solenoid Valve

Robertshaw-Fulton Controls Co. announces development of a miniature solenoid valve for use on air, water or oil.

The company states that the new valve differs from conventional models in that the flow is straight through the solenoid armature housing. The company says it believes this feature will be helpful in meeting strict space requirements of applications in vending machines and other commercial equipment.

The valve, measuring about 2 in., is resistant to moisture and is said to be suitable for use with edibles and corrosive materials. Several models are available with monel and stainless steel parts. Solenoids in all models are encapsulated in epoxy resins.

—K-17

Elevator Controller

Rotary Lift Co., Div. of Dover Corp., has announced development of a new and unique two-way leveling mechanism for oil-hydraulic elevators.

According to the firm, the mechanism is the first ever to be included as an integral part of an oil-hydraulic control mechanism with unitized construction.

Unitized Construction, the company explains, represents a combination of oil valves operating within one housing to control the movements of an oil-hydraulic elevator. The two-way leveling feature causes an elevator traveling upward or downward to decelerate at a given distance before reaching a floor level. The elevator then moves to a smooth and accurate stop within 1/4 in. of the landing level, it is reported.

The company states the new valve is unaffected by extreme variance in internal oil line pressure caused by very light or heavy loads on the elevator platform. The two-way leveling oil control mecnanism was formerly very sensitive to pressure change, the company says; thus when a very light or very heavy load was placed on the platform, the elevator might stop above or below floor level.

—K-18

Link Type V-Belting

A new link type V-belting is being distributed by Dayton Rubber Co., Dayton, Ohio.

Known as Thoro-Link V-belting, it is designed for use where the conventional or endless type of V-belt cannot be installed or replaced without causing costly machine down time. The new link belting is said to be extremely flexible and to operate efficiently over small sheave diameters. Each link is pre-stretched under controlled tension. Reinforced rivets provide a positive lock-fit.

—K-19

Basic Weight Classifier

A new basic weight classifier has been announced by Exact Weight Scale Co., Columbus, Ohio, for classifying, and for process control, of products and packages by weight. The company says the unit is also designed for production line inspection of metal assemblies for missing parts, and open or closed packages for correct contents.

Adjustable crystal photocells are mounted adjacent to the visual dial on the scale. According to the company, these photocells provide a precise and reliable electric signal when the pre-set weight limits, or allowable tolerance settings, are reached.

The shadograph scale used in the basic weight classifier is offered in 34 different models. Capacities range from 2000 mg up to 100 lb. Commodity receptacles and platters are available to accommodate virtually any size or shape product, the company says. The shadoedge weight indication on an illuminated scale dial provides visual reference and eliminates parallax readings, it is reported.

Two or more of the photocells can be mounted across the optical dial of the scale to provide any number of classifications from 2 to 128. The larger number of classifications are accomplished with a projected binary coded gray scale dial mounted on the weighing mechanism. The photocells are mounted inside the standard housing.

—K-20

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Test Engineering at Marquardt

by
Roy E. Marquardt
President

Unique among air-breathing engines, the ramjet cannot run independently on the ground. Because ramjets depend on their velocity through surrounding air masses for compression of combustion air, intricate test facilities must be provided.

Marquardt Jet Laboratory simulates these high-speed, high-altitude flight conditions during ground testing. A USAF facility, combined with special USN test facilities, MJL is one of the most extensive in existence today. Valued at $18 million and occupying 8 acres of land, this dynamically functional engineering tool minimizes the number of costly trial and error flights of new engines.

Complex test cells, with associated instrumentation and computers, permit sea-level and altitude testing of full size and test-scale models. In our two sea-level test cells, high pressure air is directed over the test engine through subsonic, sonic, and supersonic nozzles, and exhausted to the atmosphere. Turbojets are ingeniously utilized in two full scale engine altitude test chambers to simulate heated and rarefied air conditions encountered by high-flying supersonic ramjets.

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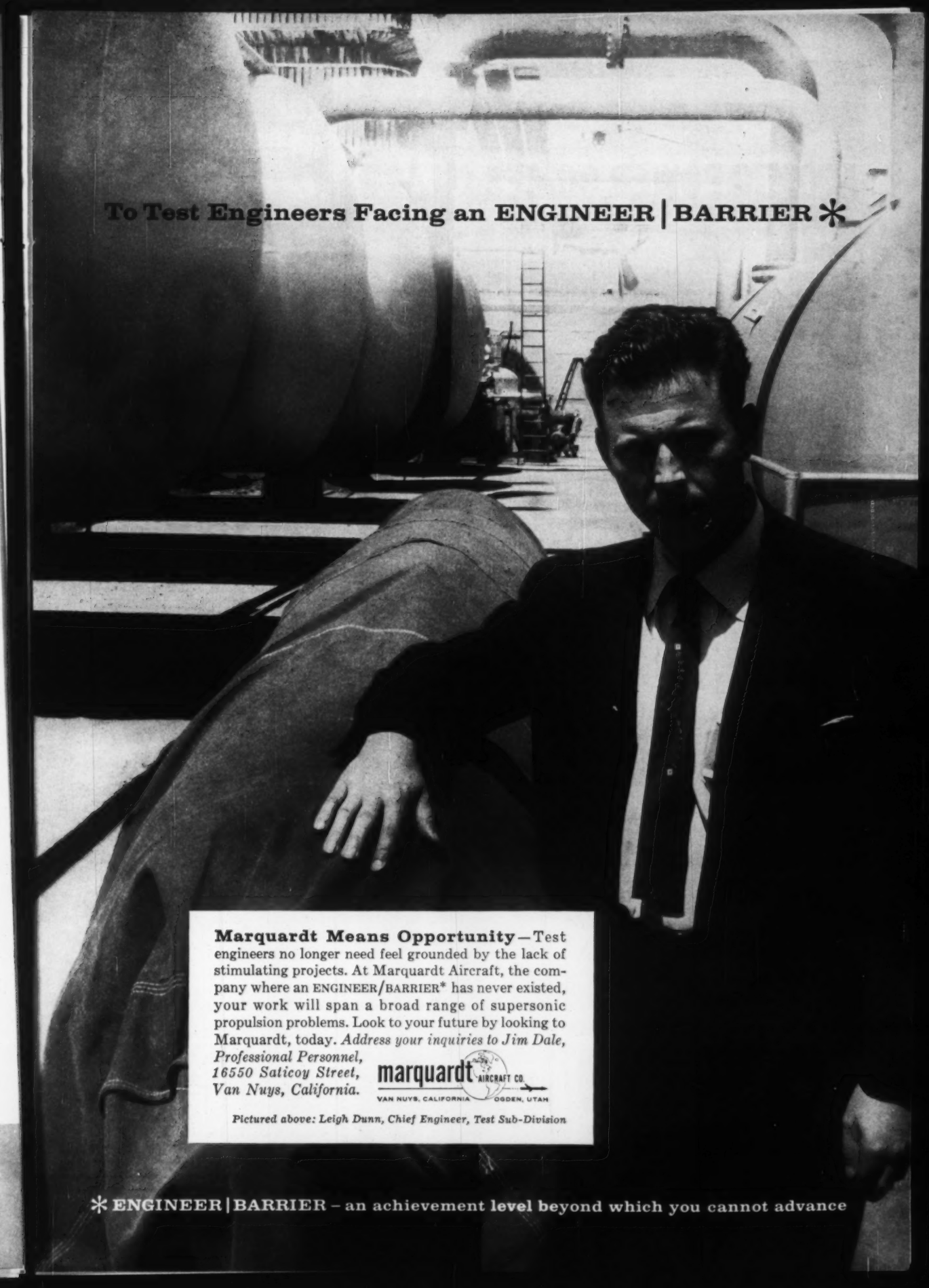

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Pictured above: Leigh Dunn, Chief Engineer, Test Sub-Division

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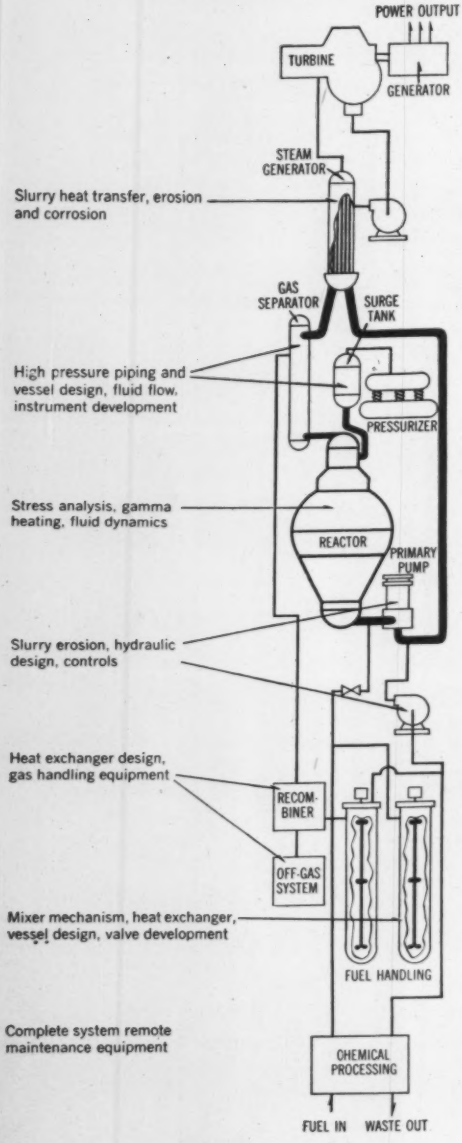
WESTINGHOUSE COMMERCIAL ATOMIC POWER COMES OF AGE

Where would you work on an atomic power plant?



This diagram shows the main parts of the world's first homogeneous power plant being developed by Westinghouse Atomic Power Department in conjunction with Pennsylvania Power and Light Company . . . and just where you would work. This pioneering plant, unlike the heterogeneous reactor, will use a liquid or "slurry" nuclear fuel, capable of continuous reprocessing.

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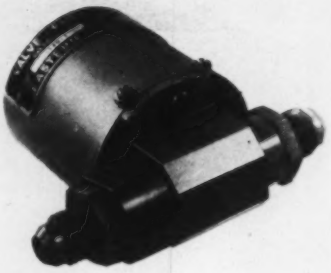

Shut-Off Drain Valve

Eastern Aircraft Products Corp., Orange, N. J., offers a new solenoid operated fuel shut-off and drain valve now in use in the aircraft and missile field.

Typical of Eastern Aircraft products, this unit features straight-through construction with low pressure drop.

Weighing only 1 lb, the new valve has passed all the requirements of Mil-V-8610 Amendment 3-valves; fuel shut-off solenoid operated, 28-v d-c—except that vibration testing above 5G acceleration has not been completed.

In continuous duty, the unit's maximum current draw is 0.65 amp at 30 v, at 68 F.

—K-21

Rack Mounted Oscilloscopes

Two new oscilloscopes, 130BR d-c to 300 kc high sensitivity oscilloscope and 150AR d-c to 10 mc high frequency oscilloscope, designed especially for mounting in a standard 19 in. equipment rack, are announced by Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.

According to the manufacturer, Model 130BR has electrically similar vertical and horizontal amplifiers which have less than 1 deg relative phase shift at 50 kc and a 1 mv/cm sensitivity. Balanced signals may be used on the most sensitive ranges, the manufacturer states, hence many transducers may be connected directly to its terminals. Mounting is by front panel or by accessory brackets which permit easy withdrawal of the oscilloscope from the rack.

Model 150AR is mounted on slides for accessibility and features calibrated sweep magnifications of ×5, ×10, ×50, and ×100; any portion of the magnified trace may be viewed, and a single sweep provision which permits unlimited sweep expansion, the firm states. This model is used with plug-in vertical amplifiers; the 151A which has 5 mv/cm sensitivity, and the 152A dual trace amplifier, which has a 50 mv/cm sensitivity and presents two electrical phenomena for simultaneous viewing. Both amplifiers pass d-c to 10 mc, and sensitivity is accurate within ±5 per cent.

—K-22

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Shock Machine

A new shock machine that is said to provide greatly increased accuracy and validity of simulated shocks in testing missile equipment has been developed by Barry Controls, Inc., 959 Pleasant St., Watertown, Mass.

According to the firm, the unit allows shock measurements to be taken with a high degree of accuracy and provides the control necessary to reproduce exactly the same wave form in repeated tests. It will generate with repeated uniformity the 100 g shock test defined by the Ramo Wooldridge missile test specification over a frequency spectrum of 100 to 700 cps. **—K–23**

Hard-Facing Alloy

A new hard, machinable nickel-base hard-facing alloy containing chromium borides is now available from Wall Colmonoy Corp., 19345 John R St., Detroit 3, Mich.

Designated Colmonoy No. 56, the new material provides protective hardness in the range of 50 to 55 Rockwell C, yet is machinable with carbide tools. The company says it was developed especially to provide the particular properties of high hardness and machinability frequently specified for extrusion screws used in the plastic and rubber industries. The alloy is said to be also suitable for wear proofing such parts as pump and valve components, dies and guides of various types.

It melts at approximately 1925 F and has an unusually low coefficient of friction which is retained as wear occurs. Abrasion, corrosion and galling resistance are excellent, as are red hardness and weldability, the firm reports. Impact resistance is rated as very good. It can be hot-formed while in the plastic range. Hard-facing deposits of the new material can be ground as well as machined with carbide tools. **—K–24**

Vibrating Feeder

A new heavy-duty vibrating feeder has been developed by Hewitt-Robins, Inc., to handle ore, coal, rock, and other bulk materials in lump sizes up to 4 ft in diam at a rate of 300 to 3000 tons per hour.

The new machine is designed for economical operation where difficult conditions are encountered, such as large lumps and heavy impact loading, severe abrasion, unusually sticky material or heavy surge loads. It is especially recommended, by the company, for handling material at primary crushers and under hoppers and storage piles where heavy tonnages and lumps are transferred to a belt conveyor or other material handling equipment. It is also recommended for those installations where continuous service and inaccessible location demand trouble-free operation over long periods of time.

The feeder is available in sizes ranging from 3 × 8 ft up to 7 × 16 ft. **K—25**

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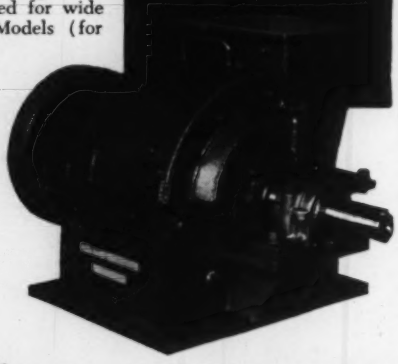

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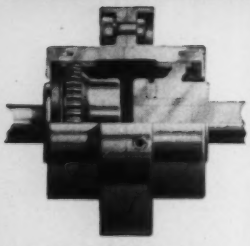

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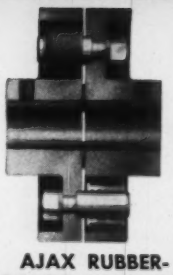

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

10,000-lb Test Machine

What is described as the first testing machine in which the center of test always remains at the same point regardless of length of specimen or amount of extension is announced by Electronics and Instrumentation Div., Baldwin-Lima-Hamilton Corp., Waltham, Mass.

According to the company, the center of test is constantly situated 56½ in. above the floor, where it is easily observed and allows such auxiliary test equipment, as ovens to remain in a fixed position for the duration of any given test. The unit is called the 10,000-lb Mark G Servomatic tester.

It employs two moving crossheads actuated by two ball and screw mechanisms and achieves a motionless center of test by making the two crossheads pull against each other or compress toward each other.

The 10,000-lb machine, powered with a ¾ hp motor, gives a test movement of 20 in. per min. Two electric clutches in the base of the machine will permit a choice of 1 to 1 and 10 to 1 speed reductions, the company reports, adding that this arrangement will, for the first time, allow the speed range to be changed while the machine is under load.

Because both heads of the machine, rather than only one head, are moving, for a given testing speed the heads of this machine need move at only half the rate required in conventional designs, the firm states. —K-26

Printing Demand Meter

General Electric Co., Schenectady 5, N.Y., announces a printing demand meter that is a self-contained model with a built-in, synchronous-motor-driven timing mechanism.

The PD-57 is intended for use with a watthour meter or a totalizing device to provide a printed record of demand. Contact-operated, the block-interval type meter records demand for each time interval on a metered circuit in numbers from 0 to 999.

Available with 15, 30 or 60 min intervals, the unit's recorded values represent the demand, integrated and averaged, over a definite time interval.

Features of the new meter include a demand-dial pointer which shows at all times the printing counter's stage of advance from the zero position; a maximum-demand pointer showing maximum advance of the printing counter during any previous interval since the pointer was last reset manually; a totalizing counter showing directly the number of impulses received from the contact device.

The latter feature provides a means of verifying the demand meter record by comparing it with the watthour meter register with which the unit is electrically coupled, the company explains.

Socket-connected, bottom-connected and switchboard back-connected mountings are available. —K-27

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Photo Comparator

A photo comparator has been designed and built by Greer Hydraulics, Inc., Jamaica, N. Y. to detect minute particles of contaminant in high pressure gases.

Originally developed as a component in the test stands for checking out aircraft engines, the unit is now being made available independent of the testing machines. The device can be used to check the operation and efficiency of filters, dryers, separators and other similar instruments when used with transparent fluids, the company states.

The comparator is claimed by the manufacturer to be sensitive to $^1/_2$ micron particles when present in quantities of 100 parts per million or more. The unit can be used in any inert gas circuit to pressures up to 10,000 psi at any normal ambient temperature, it is declared.

Small particles present in gas going through a sampling tube cross a sensitive photo-electric beam and, if in large enough quantities, will upset the unit's balance, triggering an alarm mechanism. The comparator is a self-contained completely wired unit requiring no accessories. A source of 110 v-60 cycle power with a voltage tolerance of ±3 per cent is required for the most precise operation. **—K-28**

Liquid Level Indicator

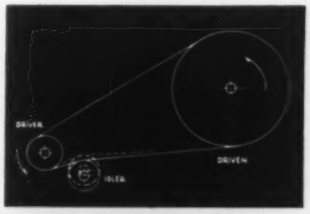
An instrument for measuring liquid levels with ultrasonics by a transistorized indicator, Model 300 Echogage, is announced by Bogue Electric Mfg. Co., Paterson 3, N. J.

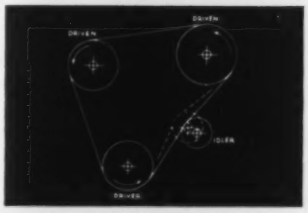
The ultrasonic pulse-ranging principle of liquid level measurement is employed to eliminate the need for floats, linkages, synchros, or any moving parts, the firm states.

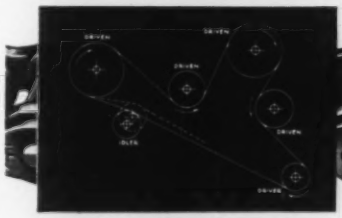
This new gage is designed to indicate accurately true liquid levels in storage tanks and dewar vessels for corrosive chemicals, liquified petroleum gases, liquid carbon dioxide, oxygen, and all cryogenic liquids. According to the firm, the unit is also suited for applications requiring the precise location of the demarcation line existing between immiscible liquids.

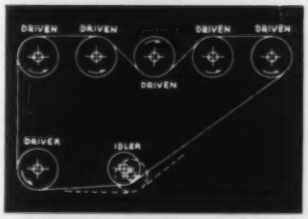
Liquid level is read directly in feet on a large meter provided with two ranges to accommodate tanks up to 15 ft high. A built-in calibration feature is designed to assure correct level readings despite changes in velocity of sound propagation caused by varying temperatures, specific gravities, and similar differences between liquids being gaged.

One common indicator will gage as many as 6 transducer-equipped tanks within a radius of 1500 ft, the firm states. Additional tanks may be accommodated by using an auxiliary switch. The indicator is fully transistorized and consumes only 5 w of 120 v, 60 cycle power. Power at the tank is not required. **—K-29**









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Submersible Fuel Booster

A submersible fuel booster pump, consisting of a centrifugal pump, an electric motor and a radio noise filter, designed for vertical mounting on the fuel tank wall of target drones and missiles, has been announced by Lear, Inc.

Pumping fuel per MIL-F-5572 the pump has a rated flow of 200 pph with a 15 psig discharge pressure. Pumping fuel per MIL-F-5624 it has a rated flow of 300 pph with a 14 psig discharge pressure. The unit is built for a 50 hr, minimum, continuous operation life at the rated conditions. The company says it will operate in an ambient temperature range from −67 to +160 F, a fuel temperature range from −65 to +110 F and altitudes from sea level to 45,000 ft.

The motor is rated at 0.06 hp, 10,000 rpm, 26.5 v d-c, with a current drain of 3.8 amp.

—K-30

Stainless Solenoid Valve

Control of high pressure corrosive gases and fluids is said to be made possible with a new, two-way stainless steel solenoid valve available from Atkomatic Valve Co., 545 W. Abbott St., Indianapolis 25, Ind.

Rated to 6000 psi, and designed for use with any media, the new valve is a direct lift type machined from 316 stainless steel barstock. Designated Series 2000, the valve is available in 1/8, 1/4, 3/8, and 1/2 in. pipe sizes. Port sizes depend on maximum pressures and viscosity of media. The valve can be supplied with an explosion-proof housing if desired.

The firm says "bubble-tight" construction is also available where positive, leak-proof operation is required. Also optional are teflon or nylon seats which eliminate metal to metal seal and assure tight closing.

—K-31

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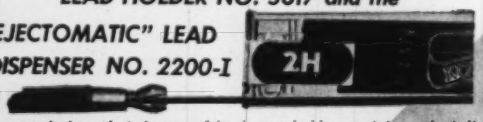
THE KOH-I-NOOR ADAPTO-CLUTCH DRAFTING LEAD HOLDER NO. 5617 and the "EJECTOMATIC" LEAD DISPENSER NO. 2200-I



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For rapid drawing of parallel lines. Set the dial for desired equi-distance, then just push the button and draw the line.

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Hydraulic Speed Control

Hanna Engineering Wks. has announced a new hydraulic speed control valve called the Flo-Set 1000. It is rated for 1000 psi hydraulic operation and is made in 1/4, 3/8, 1/2 and 3/4 in. sizes.

The valve is used to control the piston speeds of hydraulic cylinders and for controlling the speeds of other hydraulically operated devices. When used with cylinders, the valves allow the instroke and outstroke speeds to be regulated separately. This is accomplished by having a free flow through the valve in one direction and a controlled flow through the valve in the opposite direction, the company explains.

The flow can be controlled from zero to desired capacity with one revolution of the calibrated adjustment sleeve. The sleeve can be turned easily by hand or with the assistance of a wrench, the firm states.

When the desired flow rate has been established, the valve can be locked in position by means of a set screw and locking collar. Established flow patterns can be reset by referring to the previous setting of the graduated sleeve.

—K-32

Pneumatic Pressure Switch

A pneumatic pressure switch which closes a 1200 w circuit under preselected pressure, suction, or the differential sum of two pressures over a range of from 0.1-in. WC to 1 psi has been introduced by Bryant Industrial Products Corp., Cleveland 28, Ohio.

The unit is said to be adaptable to many control and safety functions and may be used to prove the presence or absence of pressure, vacuum or flow (by gaging differential pressure across an orifice) of air and inert or combustible gases.

Among the applications indicated by the company are use in automated process control; checking vacuum or pressure in manufacture of electronic tubes and electrical lamps; supervision of pressurized or ventilated refinery control houses; continuous checking of air filters, and control of gas combustion systems.

Factory-Mutual Laboratory approved for the latter use, the new switch may be applied as a standard unit to oversee every phase of the standard F-M safety cock system; automatically checking gas and air pressures to the burners, safety cock positions and recirculation air.

In the new design, pressure chambers enclose a high-stability Buna N/nylon diaphragm which acts against adjustable spring pressure to trip a sensitively mounted mercury switch.

Three interchangeable, color-coded springs adapt the switch to three pressure ranges: 0.1–0.5 in. WC, 1.0–10 in. WC, and 4–30 in. WC. A screw driver adjustment sets the desired trip pressure anywhere within the range of the installed spring, the firm reports.

—K-33

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BUSINESS NOTES
NEW EQUIPMENT
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Decade Counter

A new decade counter with an all-electronic numerical readout is now available from the Electronic Tube Div., Burroughs Corp., Plainfield, N. J.

Made up of the firm's beam switching tube type 6700 and Nixie indicator tube type 6844, the unit is described as the first basic decade counter which displays numerical information that is directly controlled by a single counter tube.

Precise in-line figures are visible 30 to 40 ft. Unit reliability and a potential counter tube life of 50,000 hr are claimed.

The plug-in units have been designed for a $3^1/_{16}$-in., panel height and may be cascaded to provide any count capacity with provisions for manual and electronic zero setting.

Three models are available covering the 10 Kc, 100 Kc and 1 Mc range. **—K-34**

Chemical Proportioner

A chemical proportioner has been developed by Johnson-March Corp., Philadelphia, to proportion its surface active wetting compound with water automatically and pump the mixed solution at variable rates of flow.

The new unit, known as the Type S liquid proportioner, is used with the latest of the company's Chem-Jet liquid dust control systems. Pump, motor and proportioner are now incorporated inside one housing.

Capacity range has been extended, with one model delivering the mixed wetting solution at from 0 to 50 gpm, and another at a rate of 40 to 100 gpm. Larger sizes are specially made for capacities up to 500 gpm. Standard inlet pipe sizes are 1, $1^1/_4$ and $1^1/_2$ in.

A dual tank system is employed offering nearly three times the usable storage capacity formerly available for the mixed compound MR-water solution. A heavy gage steel housing is provided for the proportioning equipment, pump and motor, and an 18 gage stainless steel tank stores up to 130 gal of the mixed solution. The stainless tank is more resistant to corrosion and more durable than the rubber-lined tank formerly used, the firm states.

The unit is equipped with a newly designed micro-bellows type pump said to give precise control over the amount of compound proportioned into the water line. This new pump is used in place of an eductor and rotometer, which permits more accurate variable-flow proportioning than previously possible.

In operation, the proportioner measures and pumps the surface active concentrate into the water, pipes the mixed solution into the ready storage tank, and then conveys the final liquid at variable rates of flow to the points of application in the dust control system. **—K-35**

Fluid Heat Boilers

Five new oil-fired hot water boilers designed to meet residential requirements for wet heat have been added to the Fluid Heat line of John Wood Co., Heater & Tank Div., Conshohocken, Pa.

Two of the units will be rated to 580 and 720 sq ft for forced circulating hot water systems and will be completely factory wired and assembled with burner mounted. Three of the units will be designed for 720, 995 and 1260 sq ft of hot water respectively, for either forced circulating or gravity hot water systems.

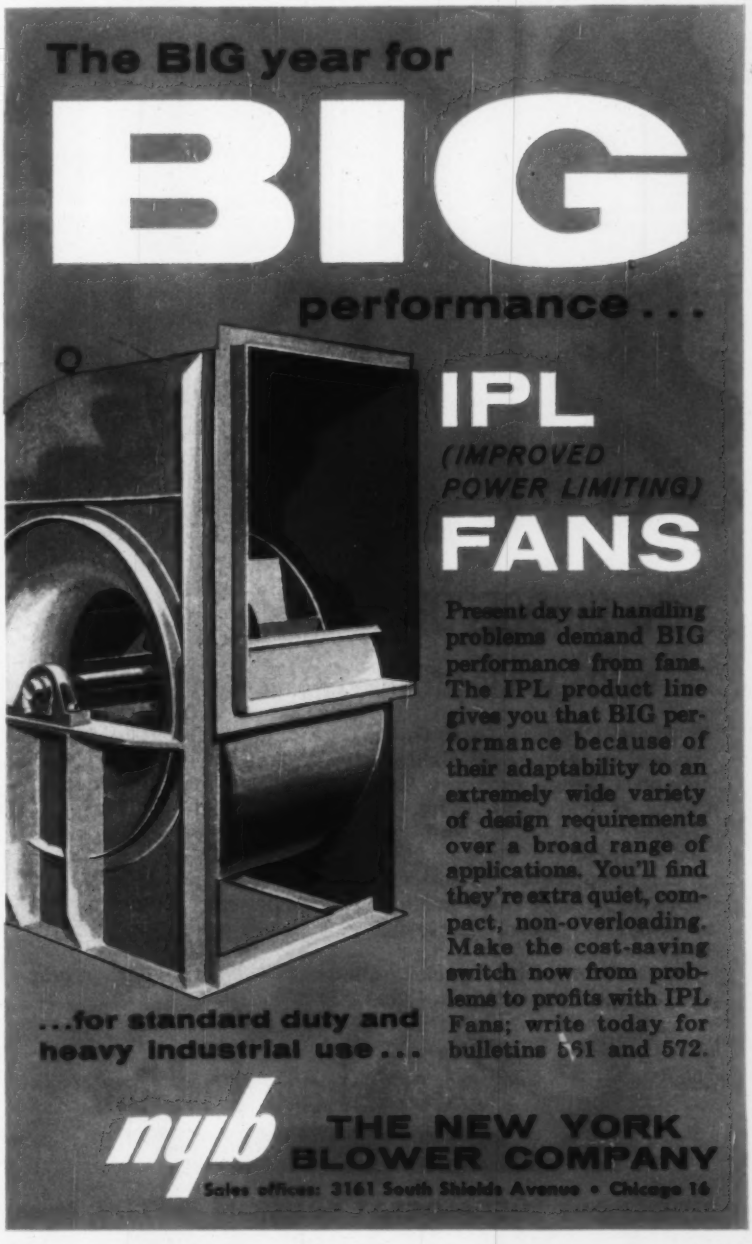
All units are designed to meet FHA standards which require ASME construction and SBI ratings. **—K-36**

Miniature Liquid Spring

A miniature Model 416 liquid spring using liquid compressibility has been announced by Taylor Devices Inc., 188 Main St., North Tonawanda, N. Y.

The $^1/_2$-in. diam, compact, self-contained liquid spring develops 800 lb force at $^1/_4$ in. stroke with an 80 lb preload and is only 2 in. long plus $^3/_8$-in. mounting stud, the firm reports. By the use of an internal hydraulic levering principle, the spring produces up to 20 times the force of a standard coil spring of the same diameter and length.

The springs, with standard $^3/_8$-24 mounting thread, are preloaded and completely self-contained, eliminating stripper bolts, washers and mechanical springs. **—K-37**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Indicating Transmitter

A compact indicating temperature transmitter has been announced by Foxboro Co. for pneumatic transmission of temperature measurement in ranges from 100 to 600 F, with spans of 100 and 200 F.

The unit has upper, more sensitive, portion of the conventional vapor pressure thermal curve expanded over a $4^1/_2$-in. scale to provide, the company says, as much as 30 to 50 per cent greater sensitivity. Use of the expanded scale increases output pressure change per degree temperature change, providing increased receiver control action and excellent readability at both the transmitter and the receiver, the firm states.

Indication at point of measurement is accomplished by red pointer and black-on-white scale markings with widening divisions across upper portion of range, providing visibility from as far away as 20 ft.

The fast responding vapor pressure thermal system includes small $4 \times {}^3/_8$-in. bulb, 18-in. bendable bulb extension, adjustable union connection and polyvinyl plastic-covered bronze tubing over copper capillary. The Class II thermal system requires no ambient temperature compensation and may be replaced easily for range change, the company says. Liquid or gas filled systems are available for temperatures above 600 and below 100 F. **—K-38**

Ultrasonic Generator

A new ultrasonic cleaning generator for pilot-plant or production application has been developed by Branson Ultrasonic Corp., Stamford, Conn.

Designed to simplify manual or conveyorized cleaning and degreasing, the Model AP-200 Sonogen will usually remove insoluble soils and contaminants more quickly than other methods, the company states. Even oil in sintered parts, blind holes, and complicated crevices is washed out easily, it is reported.

The $25 \times 17 \times 19$-in. high generator weighs 175 lb, has an average power output of 1 kw with a peak on pulses of 4 kw, and plugs into all standard industrial receptacles. Housed in a gray hammertone aluminum cabinet, it has a simple one-tube pulsed oscillator, a number of heavy-duty components and a cooling fan.

A flexible 6-ft cable connects the generator to a Type T-360 tank/transducer combination. This 25-gal capacity unit is the one most frequently used with the Sonogen generator, although several other combinations can also be driven by it, the firm reports. The welded stainless steel tank will hold organic solvents, detergent and alkaline solutions, as well as some mild acids. When strong acids are required, they are usually contained in a plastic or glass vessel, which in turn is coupled to the liquid in the tank. **—K-39**

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K-3	K-13	K-23	K-33	K-43	K-53	K-63	K-73	K-83	K-93
K-4	K-14	K-24	K-34	K-44	K-54	K-64	K-74	K-84	K-94
K-5	K-15	K-25	K-35	K-45	K-55	K-65	K-75	K-85	K 95
K-6	K-16	K-26	K-36	K-46	K-56	K-66	K-76	K-86	K-96
K-7	K-17	K-27	K-37	K-47	K-57	K-67	K-77	K-87	K-97
K-8	K-18	K-28	K-38	K-48	K-58	K-68	K-78	K-88	K-98
K-9	K-19	K-29	K-39	K-49	K-59	K-69	K-79	K-89	K-99
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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Machinery Mounts

A complete line of machinery mounts claimed to simplify installation of the heavy equipment, reduce installation time, frequently eliminate special chassis or foundations, and increase machine life is announced by Korfund Co.

The Type SW mounting, described by the company as a vibration, shock and noise isolator utilizing steel springs as the isolation medium, is available in seven load-carrying capacities ranging from 38,000 to 125,000 lb. These are claimed to be the highest capacity mounts that have ever been built. Lengths range from 20 to 35 in. and widths range from 12 to 20 in.

The design of the new unit makes it possible to adjust and level from the side, rather than by means of a bolt protruding from the top, as with conventional mounts. —K–40

Crystal Filters

Hycon Eastern, Inc., Cambridge, Mass., has successfully developed a miniaturized symmetrical bandpass crystal filter specially designed for single conversion receivers used in mobile services. Designated Model 9MA, it measures $1^{61}/_{64} \times {}^{19}/_{32} \times {}^{15}/_{16}$ in.

Specifications include: center frequency: 9Mc; passband ripple: less than $\pm{}^{1}/_{2}$ db; bandwith at 6 db attenuation: 3 Kc; bandwidth at 60 db attenuation: 12 Kc; insertion loss: less than 3 db; impedance: 1 K nominal.

The firm states that wide impedance range may be accommodated by the use of simple resonant circuits. The unit may be employed at a high impedance level to obtain maximum gain with vacuum tube circuitry, or at a lower impedance level to obtain maximum power transfer with transistor circuitry. —K–41

Large-Size Oil Seal

Garlock Packing Co. has introduced a newly designed large sized oil seal, designated Model 73-B, and intended for sealing applications on steel mill rolls and other large heavy duty machinery. Sizes are available to fit shafts of 8 in. diam to 46 in.

The synthetic rubber sealing element is specially compounded to resist oils and greases, water, mild acids, and alkalies, the firm reports. This nonporous, grainless rubber will withstand operating temperatures from −40– to in excess of 250 F, and a variety of additional compounds such as silicone rubber are available for extreme service conditions, the firm states.

The seal is fitted with a steel garter spring to assure full and effective spring action at all times. The company says stainless steel springs can be ordered for corrosive environments. The shell to which the synthetic rubber sealing element is bonded is also of steel or stainless steel as conditions may warrant. —K–42

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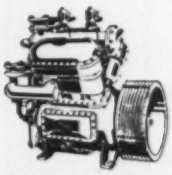
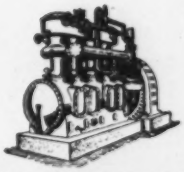
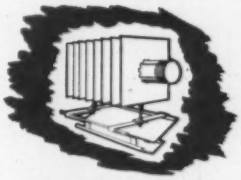
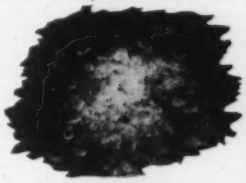
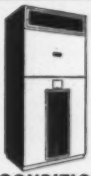

ECLIPSE COMPRESSORS


HEAVY-DUTY COMPRESSORS


PREST FIN PIPE COILS


ICE MAKERS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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Vertical Motors

Vertical weather-protected motors with enclosures built to NEMA Type II standard are now available in squirrel-cage and wound-rotor induction and synchronous types in ratings of 250 hp and up from Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

Designed for outdoor applications on pumps and other vertical drives, the new motors' ventilating passages are constructed to minimize the entrance of rain, snow and airborne particles with baffles to direct the flow of air in and out. Intake and exhaust openings to air chambers are arranged so high velocity air blown into the machine will circulate through and be discharged without entering the internal vent passages leading to electric parts.

According to the company, baffles force incoming air to abruptly change its direction—90 deg or more—before reaching the motor's electric parts. Air velocity into the machine is less than 600 rpm.

Filters are optional. A permanent wire-mesh type is used, when specified, and filter sections are accessible for inspection and maintenance, the company states. —K-43

VISCOSITY OF LUBRICANTS UNDER PRESSURE

This Report reviews twelve experimental investigations made in England, Germany, Japan, Russia, and the United States on 148 lubricants comprising 25 fatty oils, 94 petroleum oils, 17 compounded oils, and 12 other lubricants. Data collected are co-ordinated by means of sixty tables in which the results originally appearing in diversified units are compared. The methods proposed for correlating viscosity-pressure characteristics of oils with properties determined at atmospheric pressures are reviewed and illustrated. Pertinent topics such as experimental work on heavily loaded bearings, lubrication calculations, and additional techniques for viscosity are covered. Conclusions and recommendations are presented. Other sections give the required computation of temperature and pressure coefficients, a bibliography of 189 items, and symbols.

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45 years of combustion equipment design and manufacture are in back of the Dual Stage Oil Burner...and, it has been thoroughly tested and proved in the field for firing: Petroleum Processing Heaters; Rotary Kilns; H.R.T., Scotch Marine and Water Tube Boilers; etc.

Available in three sizes, the NATIONAL AIROIL Dual Stage Burner fires all grades of fuel oil from No. 2 to No. 6, with a ready capacity of 80 to 300 g.p.h. Further, for a perfect flame pattern, we would recommend using with the Dual Stage Burner either the NATIONAL AIROIL Universal Register for forced draft or, the NATIONAL AIROIL Tandem Unit for natural or induced draft furnaces.

Get detailed descriptions, illustration, and specifications in NATIONAL AIROIL Bulletin 25.

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Rotary Compressor

Described as the first single stage sliding vane rotary compressor offered in a small general utility size, a unit announced by Kellogg Div., American Brake Shoe Co., weighs 55 lb and is claimed to have a rated output equal to that of a piston unit weighing more than twice as much.

The new compressor is designated Model R-1. Manufactured in $1\frac{1}{2}$ and 2 hp ranges, the R-1 is recommended by the company for such general utility purposes as garages, service stations, paint shops, laundries, machine shops, and other operations where air pressure in constant supply is required.

The sliding vane principle of compression uses a rotor turning within an off-center housing, the company explains. Compression up to 200 psi is attained as entering air trapped between the sliding vanes is moved into increasingly smaller space between rotor and housing. The vanes are held against the off-center housing by centrifugal force, oil in constant circulation seals the compressing components. Discharge air temperature runs to about 200 F.

The unit includes a self-contained circulating oil system which both seals and lubricates. A filter system removes oil from compressed air and returns it to a sump. A cut-off switch prevents operation if oil level drops too low, the firm states. —K–44

Silicone Fluids

A new silicone fluid said to be a better lubricant than any other at elevated temperatures as high as 700 F has been introduced by the Silicone Products Dept., General Electric Co., Waterford, N. Y. Simultaneously announced was a companion product claimed to have outstanding oxidative stability.

The new Versilube fluids, designated 81717 and 81644, provide greater flexibility than previously possible in the design of hydraulic and engine lubrication systems for aircraft and missiles, the company states. Incorporating nearly all the physical properties normally associated with silicone fluids, 81717 was produced under a development contract with the Wright Air Development Center of the U.S. Air Force.

Primarily intended for use in hydraulic systems, fluid 81717 will withstand prolonged use over the −65 to +575 F temperature range. Under certain operating conditions, extended service may be attained at temperatures as high as 700 F, the firm states.

The other new fluid, 81644, is designed for use in engine and other lubricating systems where exposure to air cannot be controlled. According to the company, this material remains stable under exposure to oxygen at temperatures as high as 510 F, some 60 to 80 deg higher than possible than with previous silicone and most other lubricants. In addition, the company says, 81644 is a somewhat better lubricant than the standard lubricating silicone fluids. —K–45

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Downtime, rejects, heavy maintenance costs and too-frequent replacements can be cut down *appreciably* by the use of Shenango extra-strong centrifugal castings.

They provide a finer, *pressure-dense* grain . . . with all the weakening defects eliminated, such as blowholes and sand inclusions.

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Informative bulletins are yours for the asking. Write to: *Centrifugally Cast Products Division,* The Shenango Furnace Company, Dover, Ohio.

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(up to 150 lbs. psi.)

The No. 150 controls the boiler feed pump the one right way—directly from the boiler water level. Holds boiler level within close limits to assure maximum steaming efficiency and fuel economy. Has extra switch which provides circuits for cutting off burner and sounding alarm in case of low water emergency. It's the most widely-used, time-proved control of its kind.

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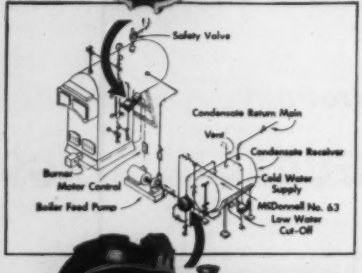
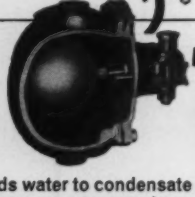
McDONNELL No. 150 PUMP CONTROL





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Adds water to condensate receiving tank whenever necessary to make up for any deficiency in returns. Large feeding capacity meets any sudden boiler demand for water. Needle and seat are stainless steel assuring powerful drip-tight closure. For tank pressures to 35 psi., supply pressures to 100 lbs.

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McDONNELL
Boiler Water Level Control
and Safety Devices

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Oil Nozzle

Milwaukee Valve Co. announces development of a new oil nozzle for general and aircraft use.

The unit, Model P-2060, features a lightweight, high strength aluminum handgrip. It is equipped with dust cap and ground cable, and is available in two sizes: $1^1/_2 \times 1^1/_2$ in. and $2 \times 1^1/_2$ in. —K–46

Electric Motor

Minneapolis-Honeywell has begun production at its Brown Instruments division of a new and powerful electric motor to operate valves, dampers and other controlled devices in accordance with signals generated by electric control instruments.

The new motor, the company announces, is designed for use with such final control elements as slip stem globe, single- and double-seated, three-way, butterfly, adjustable port, pilot-operated, and rotary stem valves, as well as dampers, louvers, rheostats, adjustable transformers, mechanical speed changers, and burner firing controls.

Two models, each having two-position, floating or proportional control forms, are available in various speeds and torques. Series 831E2 has a rated output torque ranging from 1.5 to 31.2 ft-lb. Series 831E1 torque rating ranges from 3.1 to 62.5 ft-lb. Stall torques for both series are a minimum of twice the rated torques.

The motor is said to position accurately final control elements over full drive shaft rotation. The two-position and floating control models can be adjusted for 35 to 335 deg rotation and the proportional model for 35 to 100 deg rotation without loss of reversing rotation. An external relay permits the floating model to be made unidirectional, or arranged for reversing, for more than one complete revolution of the output shaft. —K–47

Capacitor Tantalum

Capacitor grade tantalum metal has been introduced by Kennametal Inc., Latrobe, Pa.

Bars, sheets, foil, and wire made from tantalum of 99.9 per cent purity are available in production volume. In addition to these forms, tantalum metal granules, of the same high purity, will also be made available, the company reports.

According to the announcement, tantalum of such high purity is being used in the manufacture of capacitors required with transistors.

According to the company, high purity tantalum metal has an exceptionally high resistance to some of the most violent corrosive acids and vapors. This characteristic of the metal promises wide adoption in equipment for processing chemicals, pharmaceuticals and foods where freedom from product contamination and harmful reactions are essential, it is reported. —K–48

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It requires far more than theoretical knowledge to specify the correct height, diameter top and bottom, lining and type for highest boiler efficiency and lowest fuel costs.

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Installation of Lightning Rods and Aircraft Warnings
Demolition

Whatever your chimney problem may be, Consolidated has the experience, the knowledge, and the skilled personnel to handle it.

FREE INSPECTION SERVICE

A Consolidated engineer will inspect your chimney at no inconvenience to you and when necessary, make recommendations for increased life and efficiency. This service places you under no obligation if it can be performed on a regular scheduled inspection trip.

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Calibrator, Checker

New information for all FM/FM telemetering systems can be obtained with the Model TDC-5 simultaneous 5-point calibrator and dynamic checker introduced by Panoramic Radio Products, Inc., Mt. Vernon, N. Y.

The instrument offers two new facilites: a simultaneous five-point calibrator for discriminator linearity measurements in all of the 18 RDB subcarrier channels and 5 optional 30 per cent channels; and a dynamic checker which converts phase distortion in the discriminator package into harmonic distortion which can then be analyzed on the screen of a spectrum analyzer.

The equipment is packaged in modular form with individual chassis and interchangeable crystal assemblies for each channel. Functional control and a common simultaneous output terminal is in a master unit. **—K-49**

High-Temperature Seals

A new series of high-temperature, high-reliability hermetic seals has been announced by Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

Designated Ceramicite C-200, it was developed to satisfy the need for a material which would hermetically seal to the 300 series stainless steels, the company states.

Thermal expansion of the unit is similar to type 300 series stainless steels and physically bonds to those metals and other materials with similar thermal coefficients of expansion. It is claimed to be endowed with superior electrical characteristics and high pressure integrity at temperatures up to 1100 F. The breakdown voltage of this material is extremely high, and it is acid and alkaline resistant, the firm says.

The new material is available as preforms, ready for firing in fabricating a seal component, or as complete seals. The firm has started production of multiple-pin headers and will shortly start making single-pin terminals. **—K-50**

Control Valve

A. W. Cash Co., Decatur, Ill., has developed a new high pressure control valve designed to handle gases and liquids in high pressure drop, on-off or throttling service, with dead-end shutoff.

It is designated as Cash Standard Type 505, and has split body construction with a pressure and temperature rating of 10,000 psi at −40 to 400 F. It is available with a direct or reverse action actuator with standard 3–15 and 6–30 psi instrument air range.

Body of the valve is forged stainless steel with hardened stainless steel trim. Connection sizes are $1/2$ and $3/4$ in. NPT. Connections for high pressure tubing are included. **—K-51**

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Engineering Analysis on ADVANCED REACTOR SYSTEMS.
Responsible positions

REACTOR SHIELDING - ANALYSIS

Qualifications: BS, MS Nuclear Engineering, Physics, or Math. (with good Physics background). 1-5 years' experience.

Duties: Analyze neutron and gamma-ray distribution, heat generation, shielding of cores and external systems; economic, material, and configuration aspects. Also advanced shielding studies, use of computer techniques.

STRESS - ANALYSIS

Qualifications: BS, MS, PhD (Engineering). Two to four years' stress analysis background.

Duties: Functions of position to include performing and directing structural and thermal stress, vibration, and impact analyses of advanced nuclear reactor systems.

REACTOR CORE - ANALYSIS

Qualifications: BS, MS in EE, ChE, Physics or Nuclear Engineering (special nuclear training desirable). 1-3 yrs. exp.

Duties: Perform nuclear analysis to determine critical mass, neutron flux distribution, control rod effectiveness, temperature coefficients of reactivity, reactor dynamics, and full cycle reactivity changes.

Write: Answer will be prompt and confidential.

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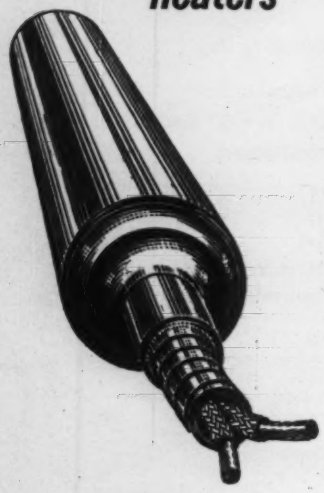
CHROMALOX

electric cartridge heaters



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New special features help Chromalox electric Cartridge Heaters provide longer life and more dependable spot heat. Use where abrasion or steam, oils or moisture limit heater life.

New high strength spring guard protects against stress and vibration. Moisture-resistant flexible brass conduit provides rugged, vapor-tight, drip-proof cover for lead wires.

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CHROMALOX — FIRST NAME IN ELECTRIC HEAT

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

High Pressure Valves

Quick connect Ermeto type valves and fittings for assembly and set-ups to 10,000 psi are available from the American Instrument Co.

Made of stainless steel, the new valves and fittings are said, by the company, to be designed to reduce set-up time. No threading or beveling is required. To prepare, the firm explains, tubing is cut to the desired length and inserted into tube opening. A nut and an internal sleeve lock the tubing securely, completing the assembly. With proper care, joints can be made and broken many times without imparing the efficiency of the joint, the company reports.

In operation, the nut is tightened and an internal sleeve is forced forward into the body taper. Pilot of the sleeve contracts, forcing the cutting edge of the sleeve to shear a groove into outer surface of the tube, making a tight joint between fitting and tube. The nut presses on the bevel of the sleeve causing it to clamp tightly to the tube. Resistance to vibration is concentrated at this point rather than at the sleeve cut. When fully tightened, the case hardened sleeve is bowed slightly at the midsection and acts as a spring. This spring action of the sleeve maintains a constant tension between the body and the nut and prevents the nut from loosening, the firm states. **—K-52**

Heavy-Duty Cutout

Westinghouse Electric Corp., Box 2099, Pittsburgh 30, announces an extra heavy-duty loadbreak cutout, Type DX, featuring a new eyebolt terminal.

The terminal is cast of high strength copper alloy and is tin plated to allow the use of aluminum or copper conductors. It accommodates wire sizes from a No. 6 solid copper to a No. 1/10 stranded ACSR, the company says. The eyebolt is capable of withstanding 350 in. lb on nut with an elongation of 0.0156 in. Tensile strength of the eyebolt and current-carrying member is 85,000 psi and 33,000 psi, respectively.

According to the company, the terminal has larger surfaces for better contact, and temperature rise tests show that the conductor operates lower than the NEMA standards limit of 30 C. Shakeproof lock washers are used to prevent loosening due to vibration. **—K-53**

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for hose and pipe

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Your fluids handling may well be improved with OPW KAMLOKS.

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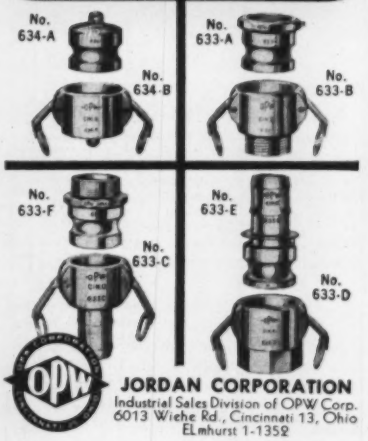

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Hanger Bearing Assemblies

A new line of hanger bearing assemblies for industrial conveyor rolls is being manufactured by Graphite Metallizing Corp.

Each assembly has a Graphalloy bushing, which, the company explains, is a dry lubricant, able to retain its properties over a range of temperatures from −450 to +750 F. The assemblies are said by the firm to be used in high temperature equipment such as dryer and oven conveyors where oil and grease can volatilize and cause product contamination or fire. They are reported to be particularly suitable for roller dryers. **—K–54**

BUSINESS NOTES

New District Office

Byron Jackson Pumps, Inc., a subsidiary of Borg-Warner Corp., announces the opening of a new district office at 2031 Ninth Ave. S., Birmingham, Ala.

Valves

Stolley & Orlebeke have been appointed exclusive agents in the Chicagoland Area for Golden-Anderson Valve Specialty Co., designers and manufacturers of valves for automation.

Ballbearing Plant

Split Ballbearing, Div. of Miniature Precision Bearings, Inc., announces a 30,000 sq ft plant, which will be located on a fifteen acre site in Lebanon, N. H., to be completed by early next summer.

At that time, Split will move from its present plant, also in Lebanon. According to the company the present workforce of 75 will be doubled when the new plant begins operating.

Properties of Steam at High Pressures

This is an interim steam table covering a range from 5500 to 10,000 psi and 32 to 1600 degrees F. It is published to provide a reasonable extrapolation of the current tables that will be useful in power systems calculations until an authoritative steam table has been published—five years hence.

1956 $1.00 20% Discount to ASME members

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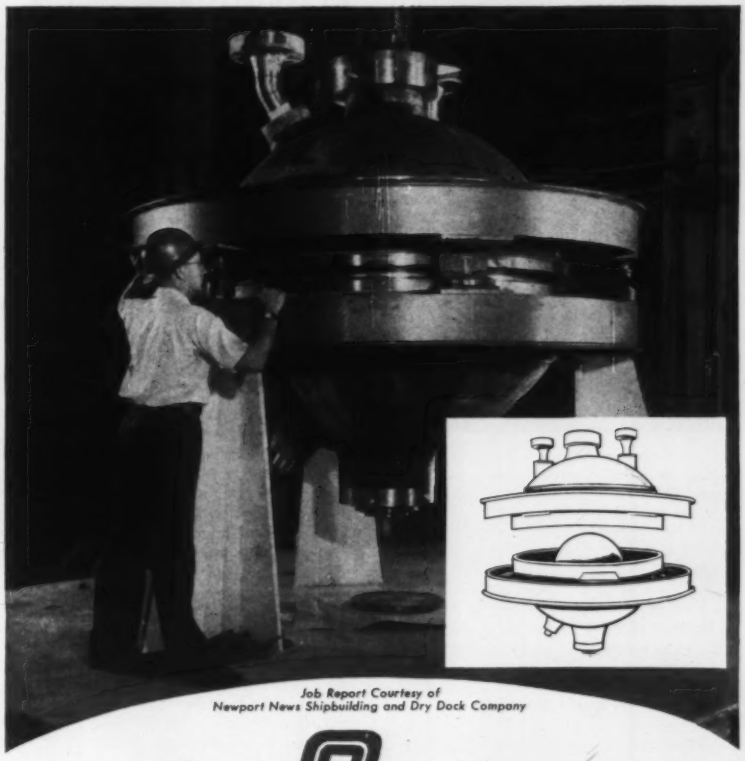
29 W. 39th St., New York 18, N. Y.

NEW WELDING PROCESS used to fabricate reactor test vessel

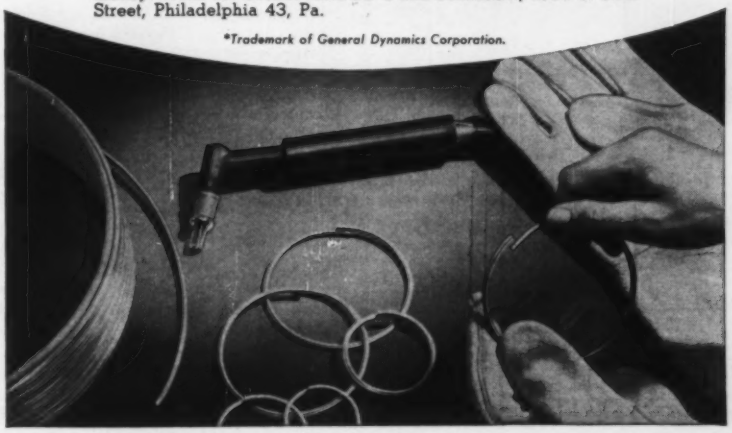


Job Report Courtesy of Newport News Shipbuilding and Dry Dock Company

the ARCOS EB* WELD INSERT

To simplify and speed joining the halves of this pressure vessel shell, and insure corrosion resistant root passes, a preplaced Arcos Consumable Insert was used. With this method, *only outside welding* was required to produce sound welds with uniform contours on the inaccessible inside surface. The welds readily passed Radiograph inspection for freedom from porosity, slag and other inclusions. The EB Weld Insert can save *you* time and money. Write for details. ARCOS CORPORATION, 1500 S. 50th Street, Philadelphia 43, Pa.

*Trademark of General Dynamics Corporation.



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10 PROBLEMS
in Supplying Steam

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- **At adjustable pressure or temperature**
- **With a constant high quality**
- **Without long steam lines**
- **To serve summer processing needs**
- **To meet extra load needs**
- **For lab, test, or pilot-plant use**
- **Where an unattended boiler is desired**
- **Where boiler space is limited**

In many such situations, a Speedylectric Steam Generator is the best or only solution. Using the electrode method of generating steam electrically, completely safe anywhere, its design eliminates low-water hazard and practically removes the need for supervision. Generation is fast, by the simplest and most economical electric method, and adjusts automatically to meet load demand. Upkeep is nil . . . there are no coils, tubes or heating elements to scale or burn out. Sizes from 2 to 50 Bhp, 15 to 500 psi. Higher pressures are available. Electric power 220, 440, or 550 volts A. C. UL listed, ASME code.

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

New Conveyor Plant

New plant facilities consisting of 40,000 sq ft of manufacturing area have been put into full production by Stephens-Adamson Mfg. Co., Clarksdale, Miss.

The new plant will fabricate component parts for conveyor systems which are also produced at the company's Aurora, Ill., manufacturing division. The Aurora plant will use a portion of the vacated area to increase production of Sealmaster ball bearing units.

To Construct Kiln

Construction of a modern tunnel kiln refractories plant at Bessemer, Ala., has been announced by Refractories Div., H. K. Porter Company, Inc. A general rehabilitation program at this plant, in addition to the new tunnel kiln and drier, will include new materials handling equipment and new brick making machinery, the company reports.

M-H Boosts Oscillograph Output

Completion of enlargement of production and engineering facilities of the Heiland Div., Minneapolis-Honeywell Regulator Co., Denver, is reported by the company. The firm has added an additional 12,000 sq ft to its present plant area—a 25 per cent increase—to expand production of its line of oscillographic instruments.

LATEST CATALOGS

Equipment Brochure

A 28-page brochure issued by Surface Combustion Corp., contains descriptions of the equipment engineered and built by the firm's pelletizing, steel mill, heat treat, and glass divisions, and Webster Engineering Company's boiler burner, Kathabar air conditioning and drying, Janitrol aircraft and Janitrol heating and air conditioning divisions. —K-55

Cold Headed Fasteners

Catalog No. 106, a condensed handbook on the design and use of such cold headed specialties as rivets, nails, screws, and other fasteners and small parts, is available from John Hassall Inc., Westbury, N. Y.

Data includes cost and design advantages, manufacturing possibilities and information on metals and finishes. —K-56

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THOMAS
ALL METAL
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FOR MAINTENANCE FREE POWER TRANSMISSION on PUMP, COMPRESSOR, MARINE and OTHER DRIVES

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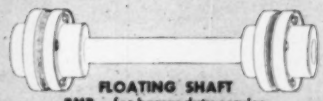

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BUSINESS NOTES
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LATEST CATALOGS

Mechanical Gap Presses

Facts on the firm's line of open back inclinable mechanical gap presses are available in Bulletin M-100 released by A. B. Farquhar Div., Oliver Corp., York, Pa.

Features and specification details for the 75, 100, 150, and 200-ton capacity presses are included. —K-57

Control Valve

A flyer, available from Atlas Valve Co. describes its adjustable cam, lever-operated valve for metering control of fuel oil in industrial oil burner installations.

The valve is designed to control and maintain a certain flow ratio between two variables such as air and fuel oil into an oil-fired steam boiler. Operating features, recommended applications and valve types, sizes and materials of construction available are included. —K-58

Straddle Carrier

Specifications and operating advantages of the Series 71 straddle carrier of 12,000 lb-capacity, are given in a four-page brochure available from Ross Carrier Div., Clark Equipment Co.

The carrier is offered in nine models and the brochure lists for each model such dimensions as load height and width, bolster length, inside height and width, over-all width and weight. Sketches illustrate turning radius. Components such as the frame, power train, brakes, hydraulic system, and steering and hoist mechanisms are described. —K-59

Type-S Controller

A 12-page bulletin, No. 900, outlining its type S controller has been prepared by the Simplex Valve & Meter Co., 7 E. Orange St., Lancaster, Pa.

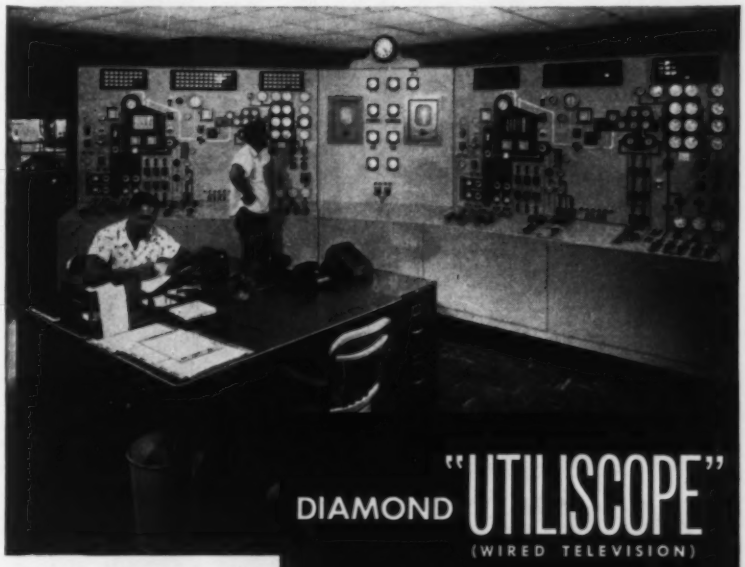
Data on details of design, capacities, dimensions, and typical installations are included for the controller, a device that can be used to regulate flows of liquids in a line and to maintain a uniform rate of filtration through each filter unit in filter plants. —K-60

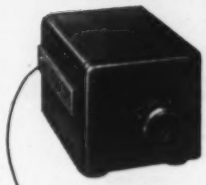
Expanded Metals

Joseph T. Ryerson & Son, Inc., announces a bulletin illustrating use of expanded metal in plant construction and maintenance, manufactured articles and ornamental and display racks.

Sizes, air flow tables and load capacities of the grating type are given. Four new patterns, supplementing the firm's standard diamond shaped opening, are shown for the material which is supplied in carbon steel, stainless steel and aluminum, in standard and flattened mesh. —K-61

AUTOMATION IN POWER PLANTS





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"UTILISCOPE" RECEIVER

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The Diamond "Utiliscope" is heavy duty equipment for power plant application. Other power plant uses are: watching flame conditions in boiler furnances, watching smoke emission from stacks, and watching remote entrances for intruders. Have you explored the "Utiliscope's" resources for saving money and improving operation? Use the coupon below for further information.

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TYPE TQL CIRCUIT BREAKERS

The "Fill 'er up!" order at gas stations is carried out with maximum protection against short circuits or overloads in the dispensing pump circuit, thanks to General Electric Company's widely-used Type TQL switching neutral, common-trip circuit breaker. This device is designed to disconnect ALL conductors of the circuit from the source of supply, thus meeting NEC (National Electrical Code) requirements.

In addition, the Type TQL breaker is available in single-, 2- and 3-pole models with plug-in features which enable it to be plugged easily into the stab and bus-bar assemblies of load center and panelboard interiors. This is accomplished by means of self-aligning silver-plated copper pressure contacts. Contact pressure is maintained by spring-steel clips.

The Type TQL circuit breaker is one of the G-E series of molded case circuit breakers which employ thermostatic bimetal elements manufactured and assembled entirely by Chace. To insure maximum circuit protection and instantaneous trip-action all Chace bimetal elements are precision-rolled to the closest tolerances, specially processed to prevent metal separation, "torture-tested" under gruelling conditions, and rigidly inspected. This 4-phase leadership program—adhered to for over a third of a century of exclusive bimetal specialization—explains why more quality-conscious manufacturers look to *quality-famous* Chace in more bimetal applications than any other company in the field.

Remember *Chace* when you design for circuit protection or temperature actuation and indication. Chace Thermostatic Bimetal is available in 28 types, in strip, coil or completely fabricated and assembled elements made to your specifications. (We do not manufacture complete controls or any other devices in competition with our customers). Write today for our new 44-page booklet, "Successful Applications of Chace Thermostatic Bimetal"—it's full of interesting applications, engineering data, and helpful ideas for your designers.

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Plastic Laminate

A bulletin published by U. S. Gasket Co., Plastics Div., Garlock Packing Co., describes the firm's corrosion resistant Kel-F plastic laminate which can be applied to any surface having almost any contour.

The bulletin, AD-152, outlines such properties of the plastic lining material as extreme resistance to chemical action of acid; zero moisture absorption; heat resistance to 300 F; low temperature flexibility; high impact resistance; antihesive surface; and a non-contaminating, nontoxic and nonflammable surface. **—K-62**

Aircraft Fasteners

A 12-page illustrated catalog, Form 8-415, describing fasteners, blind rivets and driving tools for the aircraft industry is available from Huck Mfg. Co.

The catalog describes features, specifications and driving cycles for the firm's line of aircraft fasteners, including Tau Bolt blind fastener, AL fastener, ALS stump, SAL featherweight shear fastener, SLS featherweight stump, CKL conical keystone lock blind rivet, OS oversize structural blind rivet and BL blind fastener. **—K-63**

Plug Selection

How to select the firm's plugs is outlined in a 40-page guide describing the 53,000 connectors manufactured by Cannon Electric Co.

A check-list for selecting the proper plug includes size, number and style of contacts, mounting space, coupling methods, insulation and environmental conditions. The guide also shows photographs of representative connectors, gives basic information on application, and indicates specific catalogs to order for complete data on each series of connectors. **—K-64**

Thermal Wells

Specifications on wells for thermostat applications in fluids, gases, or high pressure environments are included in a new catalog prepared by Fenwal Inc., Ashland, Mass.

The two-page catalog describes copper and stainless steel designs suitable both for immersion and surface mounting. Each of the seven designs listed has complete dimensions, operating specifications and ordering data. **—K-65**

Floating Shaft Couplings

A brochure, describing various applications of full-floating shaft couplings has been issued by the Thomas Flexible Coupling Co.

The couplings described in the brochure, Bulletin 98, are used to connect shafts that are spaced far apart. They are recommended by the firm for cooling tower drives; fan, pump and compressor drives; heavy engine drives; paper-mill machinery; marine drives; and high-speed blowers and compressors. **—K-66**

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Boiler Control Systems

Bulletin 1038, published by Copes-Vulcan Div., Blaw-Knox Co., describes the firm's boiler control systems for large utility power stations.

Using the new 900,000-lb-hr unit in the Seward Station of the Pennsylvania Electric Co., as an example, the 12-page bulletin describes components, combustion, fuel cutback, pulverizer temperature, feedwater, feed pump recirculation controls, and an automatic-sequential soot blowing system.

—K-67

Shaft Retention Fasteners

An eight-page booklet published by Fastex Div., Illinois Tool Wks., illustrates and describes the company's line of Springrip and other shaft retention fasteners.

The catalog explains the firm's new pilot tooth design said to make its fasteners easier to apply. In addition to application information, the booklet includes dimensional data and specifications on standard fasteners. Units with both internal and external teeth are covered.

—K-68

on guard

Yes, she's never off duty in guarding family health. She balances the family diet, takes the children for their "shots," prods her husband to get his annual checkup. But what about *her* health?

Caring for herself is the greatest gift a woman can give her loved ones.

So don't delay – see your doctor about *your* checkup. It's "*living insurance*" against cancer.

AMERICAN CANCER SOCIETY

EVERY ENGINEER will want a copy of this NEW BULLETIN

BULLETIN No. 31

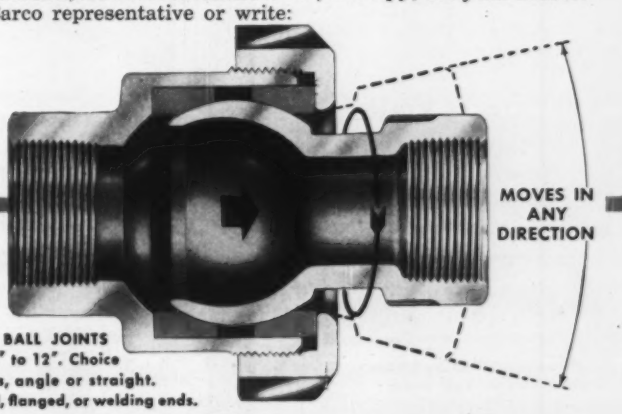
HOW TO SOLVE

PIPE EXPANSION PROBLEMS

CERTAIN distinctive characteristics and features make Barco Flexible Ball Joints particularly well-suited for solving many present-day plant piping design problems, especially for *Steam Service:*

1. **Ability to handle compound movement (where twisting is combined with thermal expansion and contraction).**
2. **Virtually no deterioration. Able to stay in service for years without repairs or maintenance. No lubrication.**
3. **No heavy pipe anchoring required. No "end thrust" developed under pressure. Minimum space needed for installation.**
4. **Maximum safety for high temperature applications. All-metal construction available. Special metals can be specified.**
5. **Basic design is pressure sealing against leakage and self-adjusting for wear. Suitable for steam pressures to 750 psi and higher.**
6. **Easy to engineer joints into piping to provide for any degree of flexibility, expansion, or movement required.**

New Bulletin No. 31 contains interesting diagrams showing how to solve many common pipe expansion problems EASILY, ECONOMICALLY. *Ask for a copy;* see your nearest Barco representative or write:



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Sizes ½" to 12". Choice of styles, angle or straight. Screwed, flanged, or welding ends.

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The Only Truly Complete Line of Flexible Ball, Swivel, Swing and Revolving Joints
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Senior Mechanical Engineers are required in Link's expanding precision gear and gear assembly departments.

If you have a mechanical engineering degree and at least 5 years' experience in this or related fields, including virtually all types of gears, gear checking equipment, methods and special techniques, here's a position that offers not only a rewarding present but unlimited growth potential as well.

Link Aviation offers stimulating associations and a friendly working atmosphere. Link is located in Binghamton near the heart of upstate New York's recreation-land. Only 180 miles from New York City, Binghamton provides "hometown" comfort with big-city conveniences.

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LATEST CATALOGS

Gas Turbine Sound Control

How noise of a gas turbine engine can be effectively silenced is explained in a 12-page brochure published by Industrial Sound Control Dept., Koppers Co.

The brochure outlines ten steps which will enable a gas turbine engineer to determine what type of sound control unit is necessary to silence his turbine. This is possible, the company says, because the firm's gas turbine silencers are standardized and because the range of types and sizes are applicable to a wide variety of conditions. —K-69

Industrial O-Rings

Chicago Rawhide Mfg. Co., Chicago 22, Ill., announces availability of a full range of industrial O-rings in standard sizes and compounds.

Information on sizes and compounds available in the new series is given in the company's Bulletin OR-57. It lists standard O-rings keyed to the new uniform numbering system in accordance with SAE Aeronautical Recommended Practice 568, cross-referenced to sizes in the 6227, 6230 and 6290 series. The bulletin also lists compounds. —K-70

Dust Filters

W. W. Sly Mfg. Co. announces a 36-page catalog describing its line of dust filters and giving information about dust control systems.

Contents include a description of the operating principles of the firm's Dynaclone dust filter. Information, capacities and dimensions are given for continuous dust collection; intermittent filters for noncontinuous applications; and the firm's unit and economy filters for use where limited air volumes are to be handled. —K-71

Steel Tubing Weights

Instructions for determining the weights of square and rectangular steel tubing are featured in a 12-page booklet available from Revere Copper and Brass Inc.

A standard factor for converting the round steel tubing weights to square or rectangular tubing is given in the booklet. Included are tables covering sizes ranging from $^1/_{16}$ in. OD with a .004 in. wall thickness to $10^3/_4$ in. OD with a $1^5/_8$ in. wall thickness. Data in the booklet is applicable to either welded or seamless steel tubing, and weights for average and minimum walls are listed. —K-72

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Air Cleaning Equipment

Westinghouse Sturtevant Div., announces a booklet on its new Precipitron models PA and PF air cleaning equipment. The booklet contains pictures, descriptions, capacities and dimension charts for the new models. —K-73

Oval Demand Storage Unit

A descriptive data sheet, Bulletin No. 571, covering a new oval demand-type storage unit has been released by Gear-O-Mation Div., Michigan Tool Co.

The storage unit, designed for all types of parts that roll, uses a rotating belt for parts propulsion around a spiraled retaining track. The two-page data sheet includes photographs, specifications, capacities, and a description of the storage unit's operation and application. —K-74

Refrigeration Equipment

An institutional brochure released by Wolverine Tube Div., Calumet & Hecla, Inc., outlines the company's services for manufacturers of refrigeration and air conditioning equipment.

Facilities, engineering capabilities and diversification are described along with the firm's product line. A refrigeration cycle unit illustrating where the company's products are used is included. —K-75

Power Transmission Chain

Chain Belt Co. announces publication of Catalog 610, "Mechanical Power Transmission and Conveying Machinery," containing descriptions, specifications, application information and selection data on products for power transmission, conveying and elevating service.

The forepart of the book has two pages of data to simplify selection of chain for common types of application, and additional detailed selection information is presented at the beginning of each major chain classification. —K-76

Hydraulic Fluids

Bulletin No. 1300SA published by Vickers Inc., describes characteristics of petroleum base and fire-resistant hydraulic fluids.

Subjects included are viscosity recommendations, prevention of rust and corrosion, reservoir requirements, connections and leaks, filters and strainers, cleaning the system, preventive maintenance. The 24-page bulletin is for industrial use and does not apply to fluids for aircraft or mobile hydraulic equipment. —K-77

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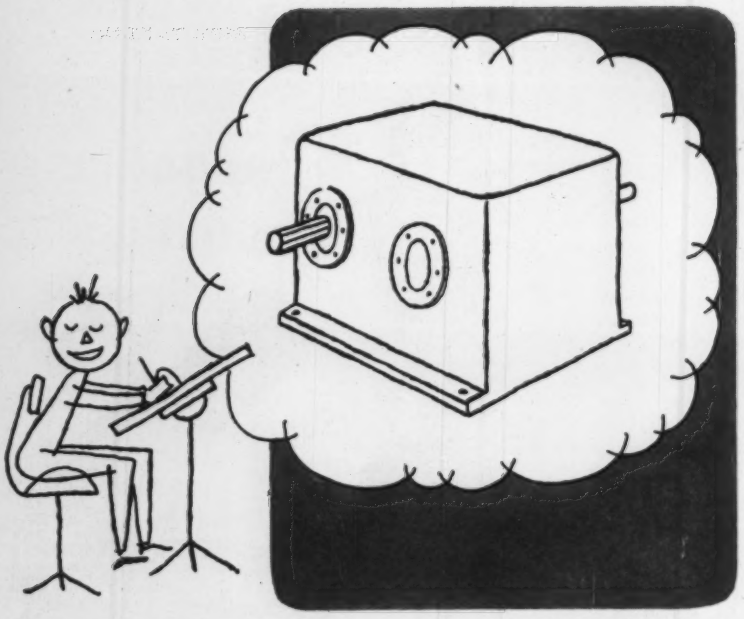

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Now you can get top quality CINCINNATI GEARS in *Custom Gear Boxes of your own design.* Speed reducers, speed increasers, planetary units, geared heads. We will manufacture the complete box to your specifications, *and to your satisfaction!*

We *know* gears — how to make and assemble them. Every shaft, bearing and gear in a Cincinnati custom gear box will align and operate properly. Every Cincinnati custom gear box will give you *guaranteed quiet, smooth operation.*

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Custom Gear Makers Since 1907

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Steel Flooring

Five different types of steel for floors, stairs, steps, ramps, catwalks, platforms, and similar applications are described in bulletin available from Joseph T. Ryerson & Son, Inc., Box 8000-A, Chicago 80.

The bulletin includes tables of safe loads and other engineering data. Illustrated are the four way raised-lug pattern solid steel safety plate, and nine different styles of open material. Plate and panel sizes, construction advantages, hints when ordering, and fastening methods, are included in the eight pages of data. —K-78

Drainage Pumps

Electrically-driven drainage pumps designed to handle water high in solid content and pump down to 1-in. levels are described in Bulletin No. P1100 available from Sumo Pumps, Inc., Stamford, Conn.

The bulletin presents specifications of the pumps, fabricated of aluminum, stainless steel and bronze. A built-in thermostatic cut-off and automatic reset is designed to provide automatic protection against overheating and overloading. The firm says the units are suitable either for portable service or permanent installation. —K-79

Hydraulic Lubricator

A two-page illustrated technical reference, TR-57C, giving description and operating mechanism of a lubricator actuated by a machine's hydraulic cycle is offered by Bijur Lubricating Corp., 151 W. Passaic St., Rochelle Park, N. J.

The sheet describes the firm's cyclic Y lubricator, which is designed for applications where desired oil discharge per machine cycle is relatively small. The fully automatic pump will operate on any hydraulic line pressure from 500 psi to 3000 psi, the company says. —K-80

Venturi Desuperheater

Bulletin Supplement 6D, published by Shutte and Koerting Co., Dept. FA-11, Cornwells Heights, Pa., describes a new line of venturi type desuperheaters developed as companion units to current SK venturi type desuperheaters but with emphasis on lighter weight and flexibility in water inlet location.

The Fig. 695 type is designed to reduce the temperature of superheated steam to lower temperatures required for operating auxiliary equipment and for use in process operations. Made for installation as part of the steam line, they provide straight-through flow. The bulletin pictures and describes this desuperheater, gives construction features, and includes sizes available and dimensions. —K-81

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Vertical Steam Generator

Vapor Heating Corp., announces Bulletin No. 586, illustrating and describing its Modulatic vertical steam generator in oil, gas, or combination oil/gas.

The units feature automatic control and operate at 75 to 275 psi, or higher. An 18-hp unit is rated at 15 to 150 psi. **—K-82**

Axial, Mixed Flow Pumps

A 12-page catalog describing axial and mixed flow vertical and horizontal pumps, is available from the Economy Pump Div., C. H. Wheeler Mfg. Co.

The company says the pumps are designed to pump extremely large volumes of liquids at low to medium heads in such applications as flood control, irrigation and drainage projects, large scale primary water supply, industrial and process work, and power plant condenser circulating systems. Capacities range from 5000 to 200,000 gpm, heads from 5 to 75 ft. **—K-83**

Plaster, Acoustical Systems

An eight-page folder on plaster and acoustical systems has been announced by Zonolite Co.

Principal applications discussed are gypsum plaster fireproofing, portland cement for insulating backup of curtain wall construction, acoustical sound-conditioning with machine applied vermiculite plastic, and a new method of direct-to-steel fireproofing. The folder contains specifications, fire test data, and general technical information. **—K-84**

Double-Enveloping Worm Gears

Worm gearing, supplied in individually matched sets, to provide high load-carrying capacity on small center distances, is detailed in a new bulletin released by Cone-Drive Gears, Div., Michigan Tool Co.

Worms are available with single- or double-extended shaft; gears are available, depending on size, as hub type, rim type, flange type, or shaft mounted hollow bore type. The 16-page, 2-color, illustrated bulletin, 700-C, contains specification drawings for all worms and gears, tool charts, and horsepower ratings for special gearset combinations, backlash tolerances, lubrication data, and service factors. **—K-85**

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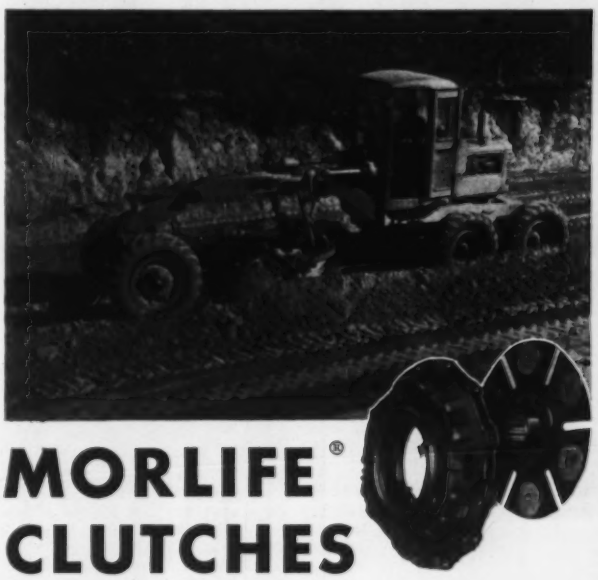

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Reports from a wide range of users state that MORLIFE clutches serve from four to ten times longer than previous types of friction clutches using organic facing materials. *Adjustments and plate replacements have been reduced to one-tenth those required by previous clutches.* The longer on-the-job hours and increased pay loads which MORLIFE clutches make possible furnish a competitive advantage for machines in which these NEW clutches are used. Increased clutch life results in decreased operation cost of vehicles or equipment. Let our engineers show you how *your* product will benefit through using MORLIFE clutches.

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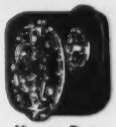
Heavy Duty Spring Loaded

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ADVANCED!

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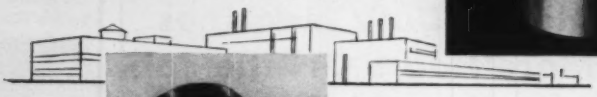
The newest facilities for the production of bearings and parts made of Sintered Powdered Metal and Cast Bronze Alloys are offered to designer, engineer and machinery manufacturer by The Bunting Brass and Bronze Company.



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Duplex Transfer Valves

A. W. Cash Co. has published a bulletin on its new type 45 duplex transfer valve designed to provide transfer from one strainer or heat exchanger to another.

The firm reports the valve can be used in other situations where one unit is to be used at a time and quick switch-over to another similar unit is required. The bulletin contains design and performance information and lists sizes available. —K-86

Hydraulic Centrifugal Pumps

A bulletin describes Ingersoll-Rand's centrifugal pumps designed for continuous heavy-duty operation within the medium pressure range.

The flyer includes cross-sectional views and a table of pump dimensions. The pumps, RT, RTS, and RTL units are meant for general hydraulic service. They are said by the company to be especially suited for steel-mill descaling, mine drainage, pipe-line pumping, and boiler-feeding. —K-87

Grit Collectors

"Grit Collecting and Grit Washing Equipment," Book 2571, is being distributed by Link-Belt Co. The 28-page book contains design data on seven types of grit collectors, two grit washers, and the Tritor screen, which is a combination grit collector and mechanical screen manufactured by the company. Essential equipment is shown for numerous applications. Detail drawings and specifications are included. —K-88

DEFINITIONS OF OCCUPATIONAL SPECIALTIES IN ENGINEERING

A good book to consult for authorized definitions of approximately 500 occupational specialties in engineering.

Prepared by the ASME with the assistance of representatives of pertinent national Engineering Societies.

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KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Pneumatic Conveyors

A new four-page bulletin, P58G, has been issued by National Conveyors Co., describing pneumatic conveyor systems for handling bulk materials such as polyethylene and other types of plastic pellets, lime, alum, glass cullet, fine metal chips and borings, small parts and press scrap. —K-89

High-Temperature Alloys

Two 28-page properties booklets on the firm's Alloy No. 25 and Hastelloy alloy X are now available from Haynes Stellite Co., Div. of Union Carbide Corp.

Alloy No. 25, is a wrought cobalt-base high-temperature alloy used for many jet engine applications. Alloy X is a nickel-base high-temperature alloy available in both wrought and cast form. It has high oxidation resistance at temperatures up to 2200 F. Both booklets contain physical properties, short-time tensile data, and stress-rupture and creep data. Separate sections describe methods for welding, forming, and machining each alloy. —K-90

New Reliance Motors

Totally-protected a-c motors from 1 through 125 hp are discussed in Bulletin B-2506 published by Reliance Electric and Engineering Co. Also described are new NEMA large-frame a-c motors and their modifications. —K-91

Squarehead Cylinders

Anker-Holth Div., Wellman Engineering Co., 2723 Connor St., Port Huron, Mich., announces a 30-page data bulletin giving engineering specifications, ordering information for recently-introduced squarehead hydraulic cylinder line.

Of tie-rod construction, the line is rated for 2000 psi working pressures, up to 3000 psi in nonshock service. All mountings are available, standard bores range from $1^1/_2$ through 12 in. According to the firm, standardized mountings provide complete interchangeability with most makes of squarehead cylinders. Double and piston rods and other special features are optional. —K-92

Pump Castings

Meehanite Metal Corp. announces a 20-page bulletin showing pump castings and the various pump types that use the firm's castings. Included are tables illustrating property evaluations made from tests covering wear, resistance to acid corrosion, impact, and erosion. —K-93

Industrial Heaters

A 26-page product bulletin, describing the construction, application, and performance features of the Herman Nelson industrial heater, has been released by American Air Filter Co.

Bulletin No. 750A explains the operation of the heating and ventilating unit designed to meet industrial requirements for either make-up air or plant heat load. Six pages are devoted to explanations of applications and arrangements of horizontal, vertical upright, vertical inverted, and ell shaped units, fan sections, coil sections, filter sections, damper sections, bases, wall intakes and humidifiers. —K-94

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NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Nuclear Water Treatment

The story of water treatment at the Duquesne Light Co. plant at Shippingport, Pa. is being distributed by Hungerford & Terry Inc., designers and manufacturers of the water conditioning equipment at this stationary civilian nuclear power plant. —K-95

Wrought Iron Piping

A. M. Byers Co. has announced availability of an eight-page booklet documenting more than 20 commercial and industrial wrought iron pipe installations.

The case histories are selected to show genuine wrought iron's durability under a wide variety of operating conditions, the firm states. Featured is the story of the famous wrought iron siphon installed in 1873 and still in use today to transport water from high in the Sierra Nevada's to Virginia City, Nev. ASTM specifications are contained in the booklet, as are photo-micrographs showing the physical structure of the material. —K-96

Copper Corrosion Resistance

A revised edition of "Corrosion Resistance of Copper and Copper Alloys," 32-page reference booklet, is announced by American Brass Co.

Included is a tabulation indicating the relative corrosion resistance of the principal types of copper and copper base alloys when in contact with 186 different corroding agents. —K-97

Hot-Spot Fasteners

A new family of high-temperature fasteners, said to have unprecedented static tensile and fatigue strengths at temperatures up to 900 F, is reviewed in new literature published by Standard Pressed Steel Co., Box 558, Jenkintown, Pa.

The tension and shear bolts, called Tm 9 by SPS, have immediate applications in jet engine and airframe hot spots and in high-temperature, high-pressure equipment in chemical, nuclear and power-generating industries, the firm says. —K-98

Oiling Devices

Wm. W. Nugent & Co. Inc., has issued a 26-page brochure outlining its services to industry over the past 60 years.

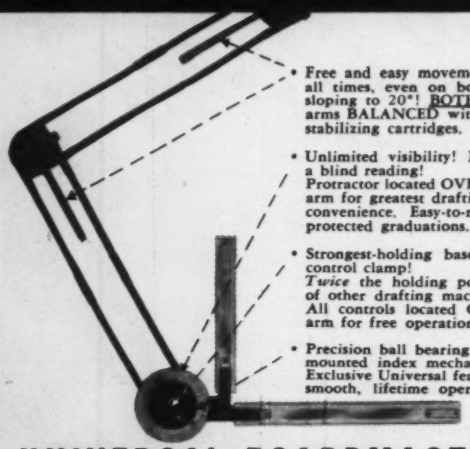
The firm, which manufactures oil filters and oiling devices, traces its history and shows its growth in both products and facilities over the years. —K-99

Silicon Carbide Materials

A new publication by Carborundum Co. features technical information on materials to meet severe or unusual conditions in processing or operation, such as extreme heat, abrasive action, corrosion, or other problems beyond the capabilities of conventional materials.

The first issue gives data on a new self-bonded KT silicon carbide said to provide high strength and other outstanding properties up to 4000 F. Thermal shock problems are treated, a new improved heating element is discussed and new uses of zirconium are explained. —K-100

WHAT TO LOOK FOR IN A DRAFTING MACHINE



• Free and easy movement at all times, even on boards sloping to 20°! BOTH arms BALANCED with spring stabilizing cartridges.

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• How much vibration will your product take? Where are the danger areas? All American Vibration Fatigue Testers answer these questions in your shop or laboratory with shake-down tests that simulate field service vibrations. Engineering gets the facts needed to improve design at lowest cost. Equally effective in spot-checking production runs.

• All American Testers meet U.S. Government specifications for horizontal or vertical vibration testing of all sizes and shapes of units weighing up to 150 lbs. Range Selector automatically controls acceleration and deceleration, or holds vibration frequency at any desired point between 5 and 100 cycles per second.

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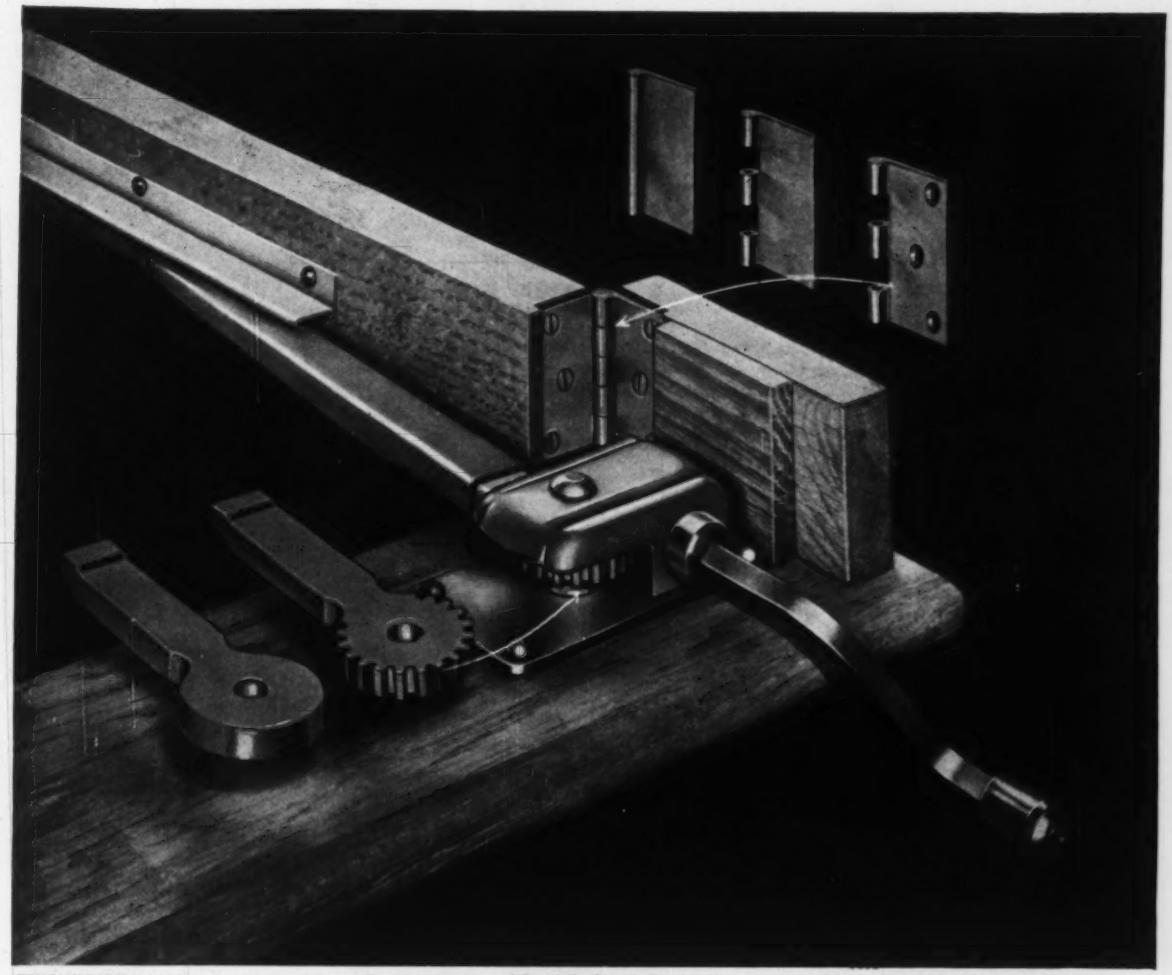


DEMONSTRATION UNIT for the Casement Window Operator, a product of The H. S. Getty & Company, Inc., subsidiary of Trans Continental Industries, Inc. At left on sill is Anaconda Die Pressed Forging for the operating arm gear. To its right is the finished part after trimming operations around circumference of gear head and in the hole—and hobbing teeth in. Upper right: hinge blank cut from long mill length of an Anaconda Extruded Shape – blank with slots milled and pinholes drilled in knuckles – finished hinge leaf.

How Anaconda die pressed forgings and extrusions cut costs for Getty*

Forgings save 30%. The H. S. Getty & Company, Inc., Philadelphia, is a leading manufacturer of marine, window and builders' hardware. They used to fabricate the operating arm gear for their casement window operator (above) from a leaded sheet brass stamping. The American Brass Company suggested a switch to die pressed forgings. Getty tried it, doing a trimming operation in the hole and periphery of the head – then hobbing in the teeth. Metal saving on each unit was 7 ounces. Machining was cut 10% – for an over-all saving of 30%.

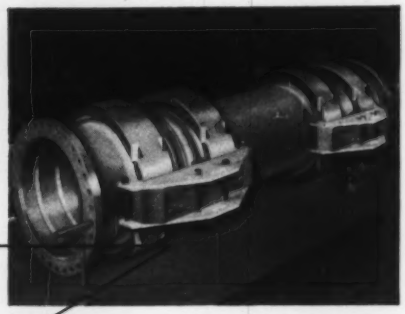
Extruded shapes cut machining and finishing. The illustrations above right show the steps in fabricating Getty butt hinges from an Anaconda extruded shape. This short cut to a superior product gave Getty a simplified shop production routine that eliminated several costly machining and finishing operations – because the extruded shape has the exact cross section of the finished hinge. And, because of the dimensional accuracy of extruded shapes, each part is readily adaptable to drill jigs and milling fixtures. These precision hinges will perform well, too, because extruded metal is *wrought* metal – tough, strong, and dense-grained.

Find out how Anaconda short cuts can help you. If the production possibilities of die pressed forgings or extruded shapes look promising to you, send us a sketch, sample, or description of each part you have in mind. We'll be glad to tell you about costs – and about possible savings, too. Address: The American Brass Company, Waterbury 20, Connecticut. 5773

*Subsidiary of Trans Continental Industries, Inc.

ANACONDA®
DIE PRESSED FORGINGS
EXTRUDED SHAPES
MADE BY THE AMERICAN BRASS COMPANY

ALL IN A DAY'S WORK at *Pittsburgh Piping*



Every Pittsburgh Piping job is different, but all are alike in one respect . . . to control the flow and harness the energy of high temperature steam, gases, or liquids at high pressures. It's all in a day's work at Pittsburgh Piping to fabricate piping for a central station, an atomic energy installation, or for industrial and processing operations. Our service includes every phase from blueprint through erection: engineering, metallurgical control, pipe bending, machining, welding, heat treating, inspection, and testing. Use these facilities on your high temperature, high pressure piping jobs.

this BIG 10-TON EXPANSION JOINT

36" carbon steel joint, weighing ten tons, for cross-over piping in central station.

and this small PRESSURE RISER CONDENSER

Pressure riser condenser, fabricated of Stainless Steel Type 347; 2 feet high; wall thickness equivalent to 4" Schedule 160S. Stainless steel pressure vessel, for atomic energy application, appears in background.

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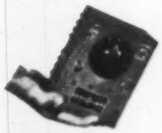
Variac® MOTOR SPEED CONTROLS

for D-C Motor Control from A-C Lines

Seven Ways Better:

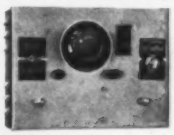
1. Variac Motor Speed Control allows maximum motor performance — motor delivers rated torque at any speed from rated to stalling.
2. Torque pulsations prevented by effective filtering of ripple currents. This is important for precision machine operations such as grinding and lapping.
3. High starting torque permits quick starting under full load conditions.
4. Good regulation allows smooth, slow starting of machines performing critical processes.
5. No electronic tubes — instant warm up and long life with minimum maintenance.
6. Motor can be stopped or reversed at any speed with one switch. Dynamic braking is a standard feature on all controls above 1/15 hp.
7. Wide-range, smo-o-oth speed variation is provided by a Variac® continuously-adjustable autotransformer.

Fifteen models are available covering motor ratings from 1/15 hp to 1½ hp. Choice of either cabinet model for installation in existing equipment, or stripped-down design for use as original equipment by machinery manufacturers. Write for complete information.



Type 1701-AK
1/15 hp capacity
$85

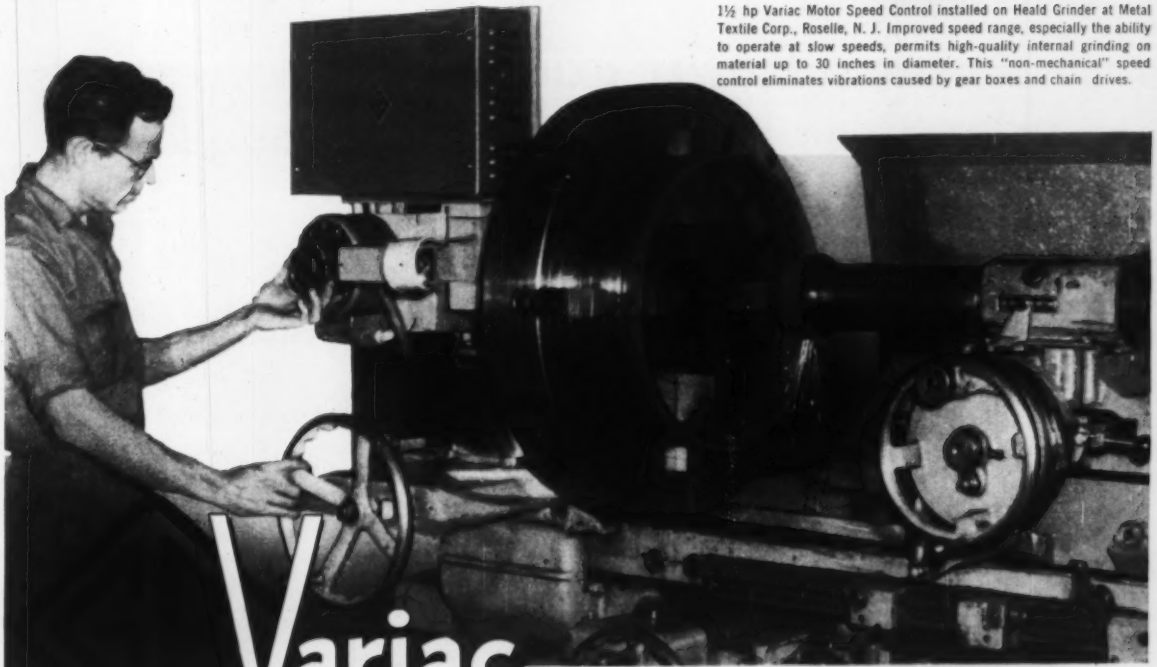
Type 1701-AKW
stripped-down model
1/15 hp capacity
$72



Type 1700-B
for 1/4 and 1/3 hp motors
$180

Type 1705-B
for 1½ hp motors
$380

1½ hp Variac Motor Speed Control installed on Heald Grinder at Metal Textile Corp., Roselle, N. J. Improved speed range, especially the ability to operate at slow speeds, permits high-quality internal grinding on material up to 30 inches in diameter. This "non-mechanical" speed control eliminates vibrations caused by gear boxes and chain drives.



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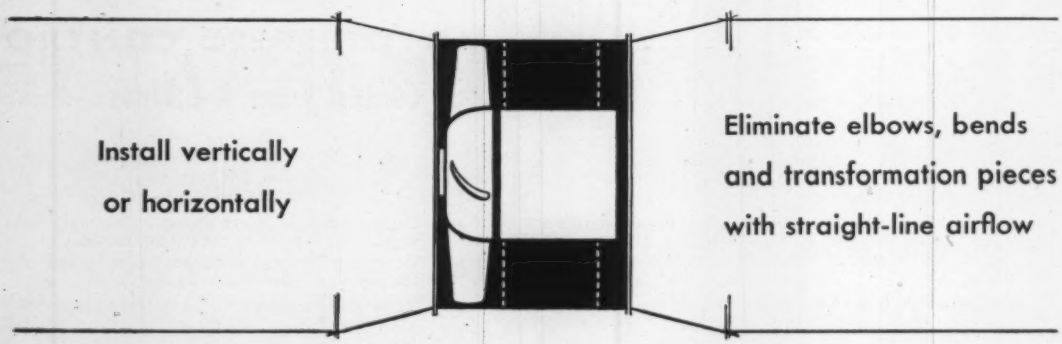
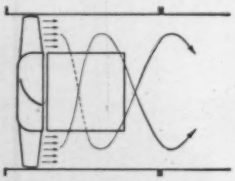
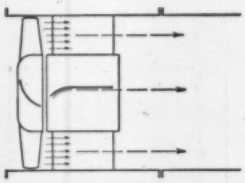


Large-diameter hub and die-formed blades insure uniform air velocity from hub to tip.



TUBEAXIAL

Air discharge follows a spiral path, then straightens out a short distance from fan at moderate pressures.



VANEAXIAL

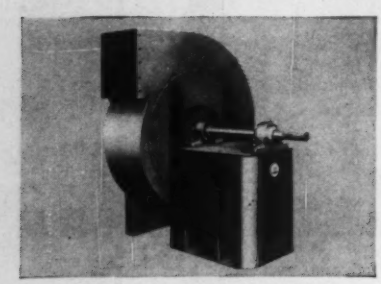
Air discharge is transformed into useful energy by directional guide vanes, increasing efficiency, pressure.

American Blower axial fans deliver the volume you need; fit the space you have!

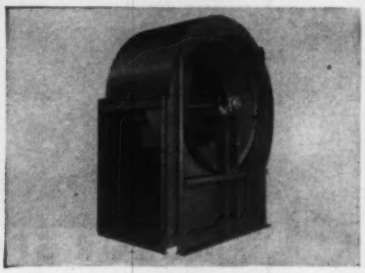
Whatever your air-moving problem – ventilating, heating, drying or processing – you'll find an economical solution in the complete line of precision-built American Blower fans. *Plus-value:* Rugged construction of every American Blower fan gives you extra years of low-cost service with minimum maintenance.

Seventy-three American Blower branch offices from coast to coast – are staffed by skilled sales engineers. Ask them to help you select the right equipment for *your* job. Call today! American-Standard, American Blower Division, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

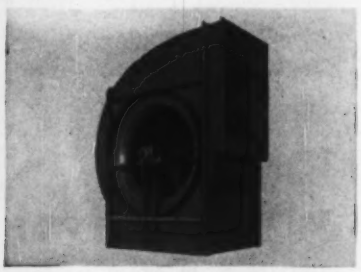
It pays to standardize on American Blower fans for every duty!



Industrial Fans—three wheel-options



HS Fans – nonoverloading, minimum power



Sirocco Fans—low speed, quiet operation

AMERICAN-Standard

AMERICAN BLOWER DIVISION

Penetrates through rust
like coffee soaks into a sugar cube!

How much do you spend on removing rust before you paint? Why not coat right over the sound rusted metal with Rust-Oleum 769 Damp-Proof Red Primer after simple scraping and wire-brushing to remove rust scale and loose rust . . . saving time, money, and metal! Rust-Oleum's specially-processed fish oil vehicle penetrates* through rust to bare metal—while the surface film remains *tough, firm,* and *durable.* You cut costly surface preparations, you receive nearly 30% greater coverage depending upon the condition and porosity of the surface—and you receive the *maximum* in over-the-years protection!

Whatever your color choice may be—Rust-Oleum finish coatings include the color you want. They're manufactured under the same *exclusive* formulation as the Rust-Oleum Primer . . . they assure you of *greater* compatibility, *double* protection, and *lasting* beauty! The best way to see what Rust-Oleum will do for you is to actually try it yourself . . . around your plant or home.

See our complete catalog in Sweets, or send the coupon for a free Rust-Oleum Test Sample . . . one brushful means *more* than a thousand words. Prompt delivery from Industrial Distributor stocks.

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This Bailey Meter Control System is —

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★ General Electric Company at its Appliance Park Boiler House, Louisville, Ky. has found that Bailey Controls help to save fuel by continuously maintaining desired operating conditions.

With a Bailey-engineered control system you can count on a high output of available energy per unit of fuel.

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When you receive equipment recommendations from a Bailey Engineer his selections come from a complete line of well-engineered and carefully tested products.

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3. Direct Sales-Service—close to you

For your convenience and to save time and travel expense there's a Bailey District Office or Resident Engineer in or close to your industrial community.

For greater fuel savings, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're glad to stand on our record.

A128-1

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for Cutting Steam Costs

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\+ Bailey Engineering
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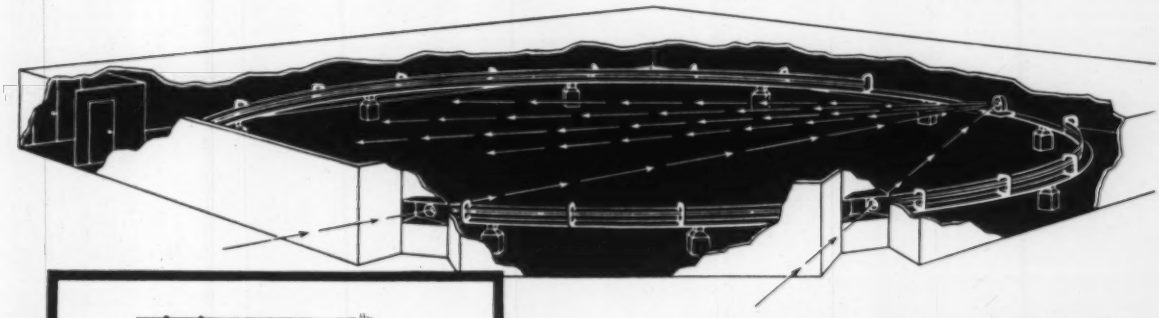
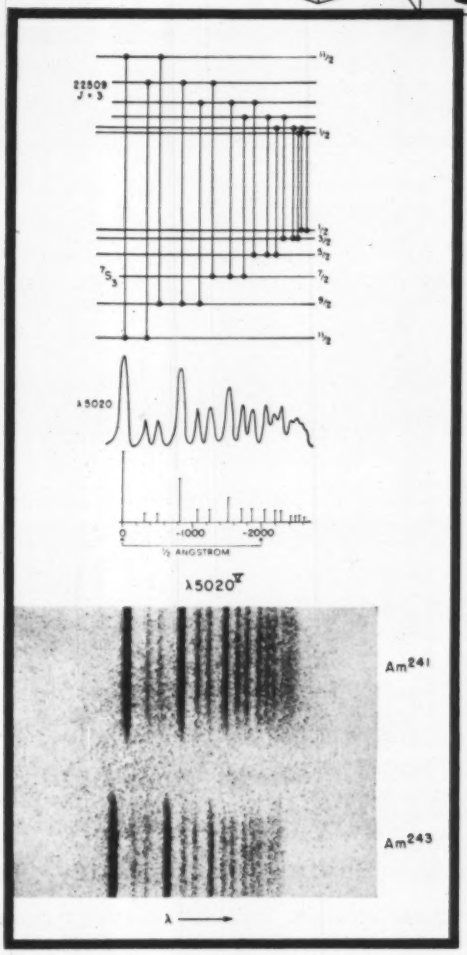
Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS

Complete Controls for Steam Plants

Progress in Leadership...



The Argonne 30-foot Paschen-Runge spectrograph with three interchangeable gratings, a plateholder accurate to .001" and a resolving power approaching 1,000,000.



Measuring americium (95) hyperfine structure and isotope shift

The high resolution and accuracy available in the Argonne 30-foot spectrograph made possible the first term analysis of a transuranic element.

An example of the research accomplished with this instrument is illustrated by the americium λ 5020 line, photographed in the fifth order. This shows that the nuclear spins of americium 241 and 243 are 5/2; the magnetic moments are in the ratio 1.008; the line is a transition between two levels with J=3, one of which has inverted hyperfine structure. Additional information concerning the electronic structure of the element can be obtained from the direction and magnitude of the isotope shift. Such studies provide a quantitative explanation for the observed differences in chemical behavior between the rare earth and the transuranic series.

The ability to examine the interaction of the nucleus and electrons leads to new information concerning a wide range of problems in atomic and nuclear structure.

Argonne
NATIONAL LABORATORY
Operated by the University of Chicago under contract with the United States Atomic Energy Commission

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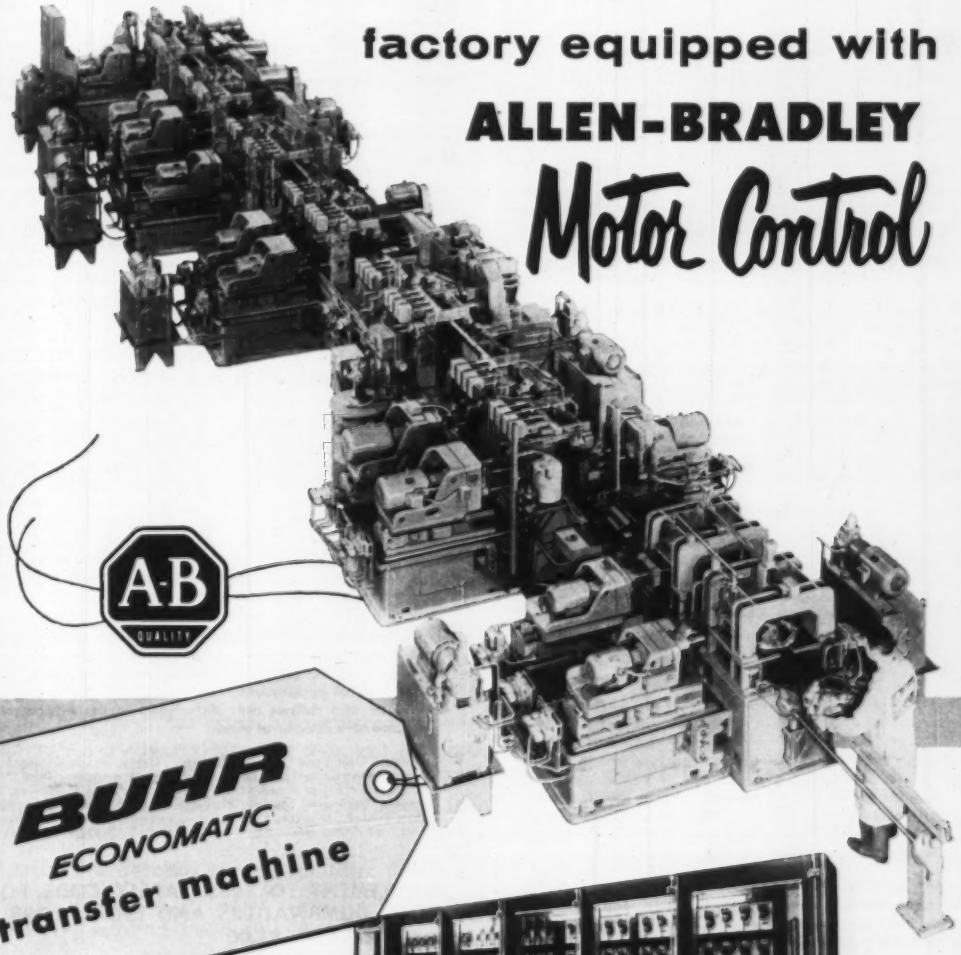
factory equipped with

ALLEN-BRADLEY Motor Control



BUHR ECONOMATIC transfer machine

The motor control panel used with this Buhr transfer machine is completely equipped with standard Allen-Bradley control units listed in the A-B Handy Catalog.

As operations required of huge automation machine assemblies multiply, so does the importance of the motor control "reliability." And for that reason Allen-Bradley—the motor control that assures *millions* of trouble free operations—is usually preferred above all others.

The simple solenoid design around which all Allen-Bradley motor starters and relays are built has only ONE moving part. There are no pivots and bearings to corrode and stick . . . assuring fast, consistent, contactor operation. And the double break, silver alloy contacts—standard through the entire Allen-Bradley line—are always in perfect operating condition. Specify Allen-Bradley control! In so doing, you can't possibly make a mistake.

Write for your copy of the new Allen-Bradley Handy Catalog—a 132-page guide to *quality* motor control.

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MOTOR CONTROL
QUALITY

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NEW AMERICAN STANDARDS

AMERICAN DRAFTING STANDARDS MANUAL

When completed, this Manual will fulfill industry's most exacting fundamental drafting requirements. Of its seventeen sections, the following have just been published:

SECTION 1—SIZE AND FORMAT Y14.1–1957 $1.00

Deals with sheet sizes; basic format; location of title and revision blocks, lists of material, and of drawing numbers; and print fold. The basic format applied to each drawing sheet size, the alternative format for vertical "A" size drawing, the layout of title and revision blocks, the positioning of lists of material, and print folds are illustrated.

SECTION 2—LINE CONVENTIONS, SECTIONING AND LETTERING Y14.2–1957 $1.50

Scope: Line symbols; visible and hidden lines; section, center and dimension lines; extension lines and leaders; cutting plane lines; break and phantom lines; section lining on detail and on assembly drawings; direction and spacing of general purpose section lines; the cutting plane; full and half sections; location of sectional views; lines behind the cutting plane; broken-out, revolved, removed, offset, auxiliary, and thin sections; sections through webs, shafts, bolts, pins; for shortened projections and rotated features; intersections in section; sizes of lettering for different purposes. Twenty-seven diagrams supplement and illustrate the text.

SECTION 3—PROJECTIONS Y14.3–1957 $1.50

Covering arrangement of views for multiple view orthographic projections, this Section describes and illustrates practices in the choice and arrangement of the views; use of partial, alternate, removed and revolved views; auxiliary views; conventional breaks; and rounded and filleted intersections; and developed views.

SECTION 4—PICTORIAL DRAWING Y14.4–1957 $1.50

This Standard defines the various kinds of pictorial drawings and describes the correct method of using them. Axonometric, oblique and perspective drawings are given consideration, and a number of examples presented showing the variety of positions in which the axes may be placed. Suggestions are given on the proper pictorial arrangement of sectional views, thread representation, the use of break lines, indicating fillets and rounds, unidirectional and pictorial plane dimensioning, shading, and phantom drawing.

SECTION 5—DIMENSIONING AND NOTES Y14.5–1957 $2.00

Defines terms used in dimensioning drawings; illustrates how dimensions and notes should be used to specify design requirements on mechanical drawings, and includes dimensioning practices for the control and form tolerancing of geometric surfaces.

SECTION 6—SCREW THREADS Y14.6–1957 $1.50

In this Standard are the approved methods of placing screw thread data on drawings; also a considerable amount of information on thread tolerances useful to draftsmen. Typical drawing notes are shown in the Standard along with specific practices for dimensioning.

Sections in preparation

***Gears, Splines and Serrations Castings *Forging Metal Stamping *Plastics Die Castings Helical and Flat Springs Structural Drafting Electrical Diagrams Tools, Dies and Gages Hydraulic and Pneumatic Diagrams**

***Expected to be published in 1958. The others are unlikely to be available before 1959.**

CARBIDE BLANKS AND CUTTING TOOLS B5.36–1957 $2.00

This is a revision of the carbide tool portion of Standard B5.22–1950. It gives definitions and nomenclature; the standard sizes, styles, designations, and dimensional specifications of carbide blanks, sintered carbide tipped general purpose tools, sintered carbide boring tools, solid sintered carbide inserts 1½″ and longer and their holders. Standard specifies tolerances; gives identification system for inserts; and material, finish and marking requirements.

20% Discount to ASME members

STEEL PIPE FLANGES AND FLANGED FITTINGS—150, 300, 400, 600, 900, 1500 and 2500 lb. (With Applicable Requirements Relative To Flanged End and Butt-Welding End Valves) B16.5–1958 $3.00

Pertaining to cast and forged steel flanges and flanged fittings and flanged end and butt-welding valves, this Standard gives the pressure-temperatue ratings, the dimensions and tolerances; covers sizes and methods of designating openings, markings, and minimum requirements for materials.

Important changes and additions in this 1958 Revision are elimination of Class B pressure-temperature ratings with a further clarification of the remaining Class (formally Class A), expanded welding and dimensional tables, pressure-temperature ratings for several additional materials, the temperature used in determining ratings redefined, gasket qualifications (their ring joints) suitable for established pressure-temperature ratings, and the method of calculating lengths of bolts which now establish stud-bolt lengths from thread to thread, and does not include the height of points.

FACE-TO-FACE AND END-TO-END DIMENSIONS OF FERROUS VALVES B16.10–1957 $1.50

This Standard covers ferrous valves of the following types having flanges and faces in accordance with American Standards; and ferrous butt-welding valves, Class 125, Class 250 and 800 lb. hydraulic cast iron valves and 150, 300, 400, 600, 900, 1500 and 2500 lb. steel valves. The approximate distances between flanges with ring joints when rings are compressed are tabulated and the flange facings and their applications are shown.

CONVEYORS, CABLEWAYS AND RELATED EQUIPMENT B20.1–1957 $1.50

This is an up to date guide on the safe construction, design, installation, operation, and maintenance of conveyors and conveyor machinery such as, power conveyors, gravity conveyors, pneumatic tubes, cableways, skip hoists, vertical reciprocating conveyors, and power unloading scoops. The Code also defines over sixty types of this equipment and includes diagrams of a number of them.

Contents: Definitions. Design Features. Design and Installation. Inspection and Maintenance. Related Structures. Operating Provisions. Prime Movers and Control. Specific Safety Regulations Applying to Aerial Cableway, Belt Conveying, Pneumatic Conveying Systems, Bucket Conveyors, Chain Conveyors, Roller Conveyors, Wheel Conveyors, Live Roller Conveyors, Vertical Conveyors, Screw Conveyors, and Aerial Tramways.

SUPPLEMENT TO 1955 SAFETY CODE FOR ELEVATORS, DUMBWAITERS AND ESCALATORS A17. Ia-1957 $1.00

This twenty-page supplement contains the amendments which have been found necessary in order to improve the Code's serviceability. Changes which affect ninety of the rules, range from minor adjustments to significant alterations and provisions such as the inclusion of a definition for the term "group automatic operation;" the new provisions for hoistway access switches, hoistway door unlocking devices, and the location of the keys for them; the expansion of Rule 204 permitting passenger and freight elevators to have two compartments under certain conditions; the additional requirements for passenger overload; and the revised rules for emergency signal devices for elevators operating without a designated operator in control.

MACHINE MOUNTING SPECIFICATIONS FOR ABRASIVE DISCS AND PLATE MOUNTED WHEELS B5.35–1957 $1.00

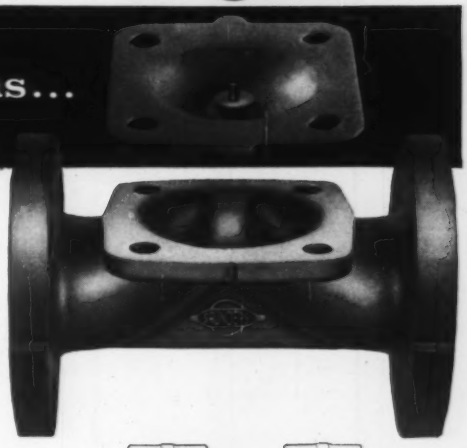
The Standards included herein cover the mounting specifications for abrasive discs and plate mounted wheels and designations such as, disc wheels, steel back abrasive discs, plates mounted wheels, nut inserted wheels, bolted on abrasive discs, etc., where the grinding is done on the exposed flat side of the wheel. Machine mounting specifications are for disc of 10″ to 16″, 18″ to 23″, 24″ and 26″, 30″, 36″, 40″, 42″, 48″, 53″, 72″, and 84″ diameters.

Published by **The American Society of Mechanical Engineers 29 W. 39 St., New York 18, N. Y.**

Outperforms other valves under SEVERE chemical conditions

GRINNELL-SAUNDERS DIAPHRAGM VALVES

with TEFLON Diaphragms...

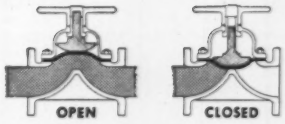


Grinnell Teflon Diaphragms are made by a special process which produces a better product of greater density, toughness and flex life.

The four case histories cited below demonstrate that Teflon offers a very high degree of chemical inertness to some of the most difficult chemicals which industry today must handle. Yet these are only a few of many success stories in the Grinnell files.

Diaphragm life depends on temperature, pressure and frequency of operation. Inquiries must include complete service data to receive prompt and careful attention.

Service Conditions	Saunders Valve Now Used	Service Life: Teflon Diaphragm	Service Life: Previous Valve
Case 1. Benzene hexachloride (30%-40% benzene, free chlorine); 120 to 130 F, 10 to 20 psi; operated 3 to 4 times daily	Glass lined bodies; Teflon Diaphragm; 1 to 3 inches	10 to 14 mos.	1 to 2 mos.
Case 2. 90%-95% HNO_3 plus 1.8% HF (specific gravity 1.62—1.77) 115 F in summer; 40 F in winter; 125 psi; operated 2 to 3 times daily	Durimet 20 body; Teflon Diaphragm; 1 to 3 inches	8 months	2 months
Case 3. $AlCl+_2$ complex; ambient to 220 F; 0-50 psi; operated 1 to 2 times daily	Glass lined bodies; Teflon Diaphragms; 1 to 4 inches	9 months	6 months
Case 4. Sulphuric acid 85%; outside temperature; no pressure; operated 4 times daily	Iron bodies; Teflon Diaphragms; 2½ inches	Still in service after 1 year	3 weeks



Features of Grinnell-Saunders Diaphragm Valves

- Diaphragm lifts high for streamline flow in either direction.
- Body, linings and diaphragm materials to suit service conditions.
- Resilient diaphragm assures positive, leak-tight closure even with grit or scale in the line.
- Diaphragm absolutely isolates working parts from fluid . . . sticking, clogging, contamination, corrosion eliminated.
- Simple maintenance. Diaphragm can be replaced easily without removing valve from the line. No packing glands to demand attention. No metal-to-metal seats to become damaged or wire-drawn.

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Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
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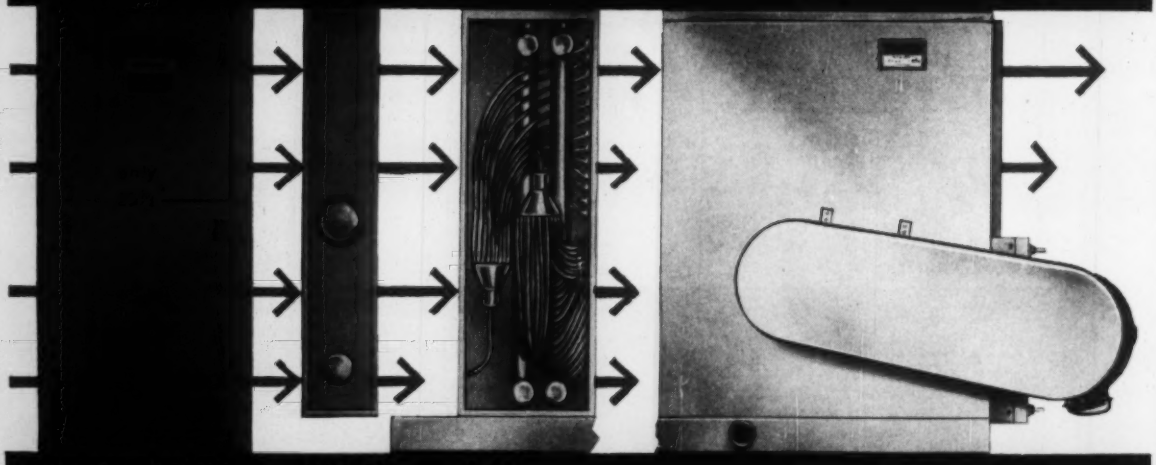
NOW YOU CAN HAVE ELECTRONIC AIR CLEANING WHEREVER AIR DISTRIBUTING UNITS ARE USED



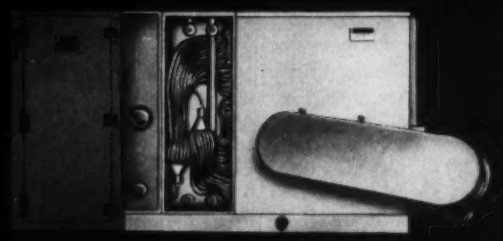
Westinghouse Electronic Air Cleaner Sections for "In-Line" Assembly . . . 25½" in direction of air flow . . . no additional access space required!

PRECIPITRON®, the original Electronic Air Cleaner, provides top-notch cleaning efficiency in Westinghouse Air Distributing Units!

Here's proof: U. S. Bureau of Standards Blackness Test . . . Ordinary mechanical filters — 5-15% efficiency

Westinghouse PRECIPITRON — 85-97% efficiency

Don't just *FILTER* your air when you can *CLEAN* it . . . inexpensively!



Precipitron Air Cleaning Section Combined With Air Distributing Units for Application at Normal Cooling Coil Face Velocities . . . Up to 28,000 CFM, Up to 150 Tons.

Westinghouse manufactured fans, motors, heating and cooling coils and Electronic Air Cleaning sections are matched together to meet your requirements for heating, ventilating, air conditioning and air cleaning . . . all with a single equipment warranty . . . a Westinghouse exclusive!

Case studies prove that in commercial installations Westinghouse PRECIPITRON pays for itself in less than one year through savings in cleaning and maintenance costs.

One Unit, One Supplier, One Price! Westinghouse now offers you the complete air handling package — Electronic Air Cleaner, heating coil, cooling coil and fan section — ready for your electrical, piping and duct connections.

More Information?

Call your nearest Sturtevant Division Sales Engineer, or write Westinghouse Electric Corporation, Dept. B-3, Hyde Park, Boston 36, Massachusetts.

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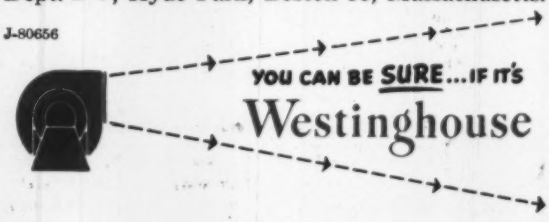

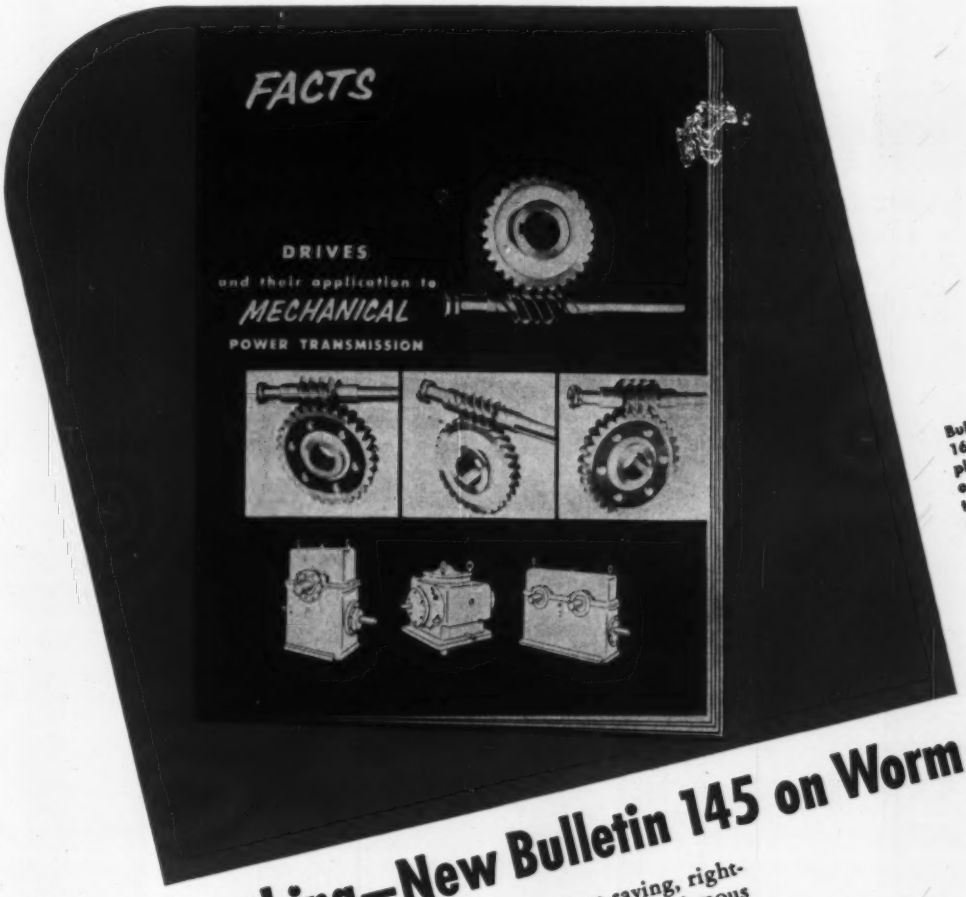

Bulletin 145 gives you 16 fact-filled pages of photographs and data on standard and custom-designed worm gear speed reducers and worm gearing components for built-in drives.

Yours for asking—New Bulletin 145 on Worm Gearing

WHENEVER you want a safe, space-saving, right-angle drive, you specify Cleveland. This famous worm-gear drive transmits power uniformly, smoothly, dependably, under even the most severe operating conditions, for a lifetime of trouble-free service. Clevelands actually improve with use. Thousands of units outlast their driven machines.

To know what Cleveland best meets any need—for speed reducer or worm-gear set—standard or special—write for new Bulletin 145. Just off press, it will bring your file up to date on this ever more popular drive. The Cleveland Worm & Gear Company, 3264 E. 80th St., Cleveland 4, O.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers, Limited.

How perfectly simple —this Fast's Coupling with purely mechanical flexibility!

1. A hub is keyed on each shaft. Hubs are splined at maximum distance from shaft ends.
2. Floating sleeves surround hubs. Sleeves are splined to engage hub splines.
3. Sleeves compensate for shaft misalignment by assuming neutral position between two hubs.
4. Because of distance from shaft end, any misalignment between splines is mere fraction of same misalignment between shafts.
5. Sleeves carried on bearing rings, located on transverse center line of hub spline faces (the load-carrying surfaces) — no crank action, no vibration.
6. Lubricant is centrifugally forced into spaces between engaged splines, forming a film.

For 35 years the most positive, dependable means of coupling machines to their power source . . . Fast's Couplings have no parts subject to repeated bending, tension or compression. Because there is no metal-to-metal contact, *there is no wear*—in fact, many Fast's Couplings in use for over 30 years show no signs of wear when disassembled! No leather, plastic or rubber oil seals. Lubricant film distributes pressure over a considerable area, diminishing localized stress at pressure points on the load-carrying teeth. Perfectly simple? Yes . . . and foolproof!

For coupling catalog, technical advice or assistance from Koppers field engineers, write: KOPPERS COMPANY, INC., *Fast's Coupling Dept.,* 3402 Scott Street, Baltimore 3, Maryland.

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This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Industrial Gas Cleaning Apparatus, Aeromaster Fans.
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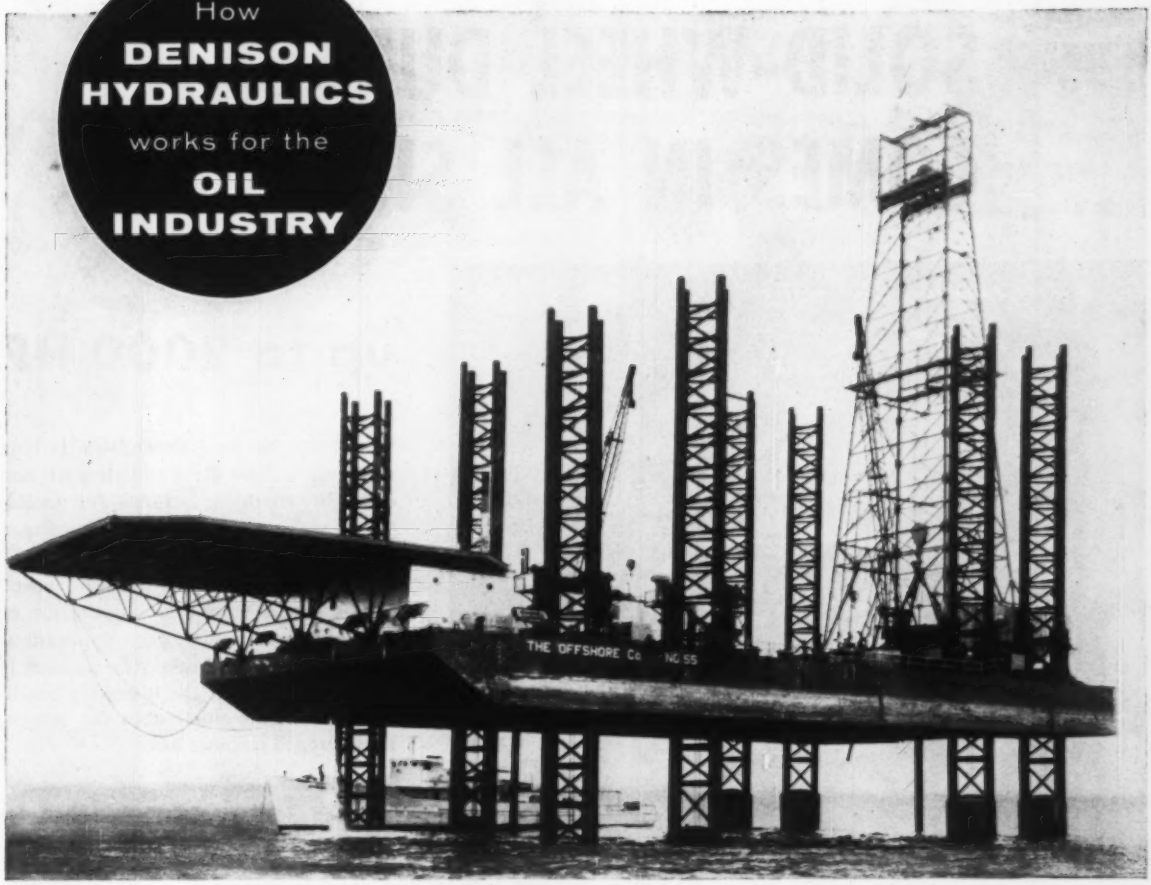
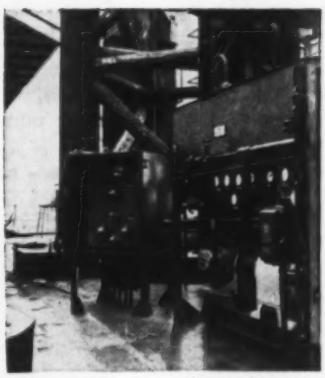


Lifts 6000 tons out of the sea with
DENISON HYDRAULIC PUMPS



***Actuating System Controls** for raising and lowering heavy off-shore rigs built by DeLong Corporation, New York. Denison axial piston pumps actuate hydraulic jacking cylinders, separately or in unison.*

When The Offshore Company faces the problem of raising its 6000-ton DeLong drill barges, they rely on Denison axial piston pumps to deliver the necessary muscle. Rated at 5000 psi continuous duty, four Denison pumps lift the 6000-ton platform at rates up to 15 feet per hour . . . with precision control from one central source.

Utilizing a Series 800, 35 gpm Denison pump at each corner, the hydraulic system developed by DeLong and built to specifications by Denison is capable of actuating lifting jack cylinders separately or in concert as needed. The result is close regulation of the massive 6000-ton load through a system of 16 individual hydraulic jacks on 8 caissons or towers.

Whatever your actuating problem, Denison can help you develop an efficient hydraulic system to do the job dependably and at low cost. Why not consult Denison on your next job. No obligation. Write us. Denison Engineering Division, American Brake Shoe Co., 1174 Dublin Road, Columbus 16, Ohio.

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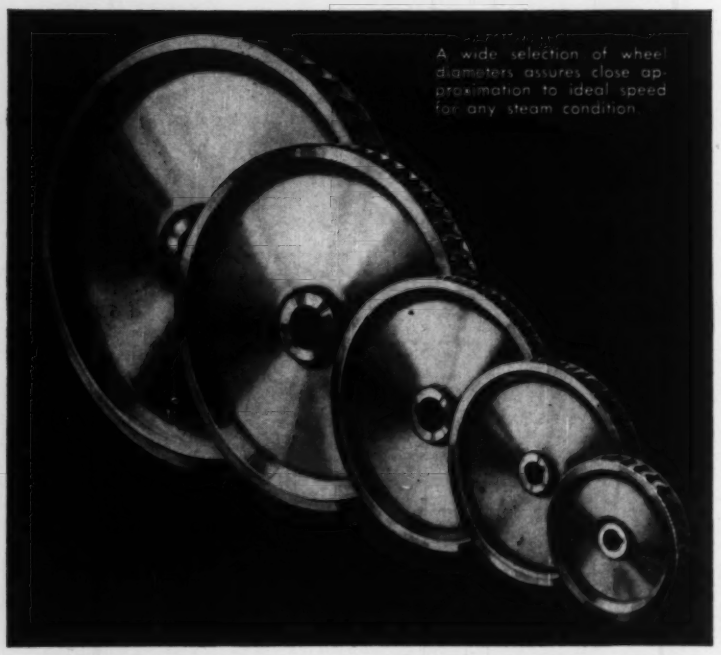
SOLID-WHEEL DURABILITY COMES IN ALL SIZES...



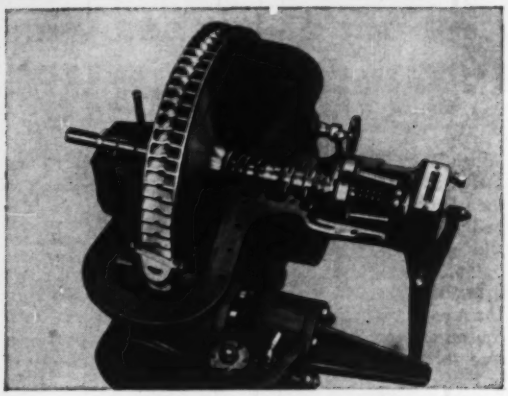
up to 2000 HP

Wherever you need dependable turbine drive up to 2000 HP—and strength and durability are major factors—Terry solid-wheel turbines are specifically equipped for the job. For, within their simple, sturdy casing is a rugged one-piece wheel.

You choose from a broad selection of sizes for all mechanical drive applications—with each Terry wheel turbine accurately proportioned to fit the operating conditions. From the smallest to the largest, these rugged turbines have:

- Solid one-piece wheel.
- Large radial and axial clearances.
- Double rim protected blading.
- Individual nozzle control.
- Dependable and durable governor.
- Heavy dust-proof bearing and governor housing.
- Independent overspeed trip with separate valve.
- Sturdy casing design.
- Strong and easily inspected steam strainer.
- Truly accessible construction, which makes inspection of the interior parts a simple matter.

For full details, send for a copy of bulletin S-116.



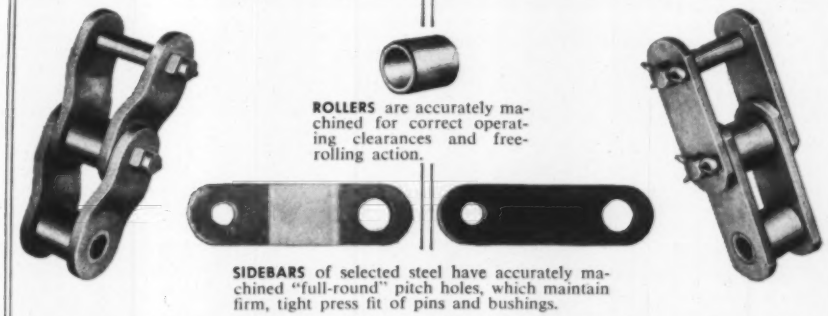
Terry wheel turbine with cover removed to show the solid wheel. There are no separate parts to loosen or work out. Blade clearances are generous.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1208

"Full-round" design of Link-Belt LXS chain avoids stress raisers



ROLLERS are accurately machined for correct operating clearances and free-rolling action.

SIDEBARS of selected steel have accurately machined "full-round" pitch holes, which maintain firm, tight press fit of pins and bushings.

FOR POWER TRANSMISSION, LXS chain is generally supplied with offset sidebars. Uniform stress distribution provides extra chain life and safe dependable operation.

FOR CONVEYING AND ELEVATING, LXS chain with straight sidebars and rollers to meet varied operating conditions. A wide variety of attachments is available.

"FULL-ROUND" PINS are made from a tough steel, specially treated for high strength in shear . . . sized for controlled press fit to prevent rotation in sidebars.

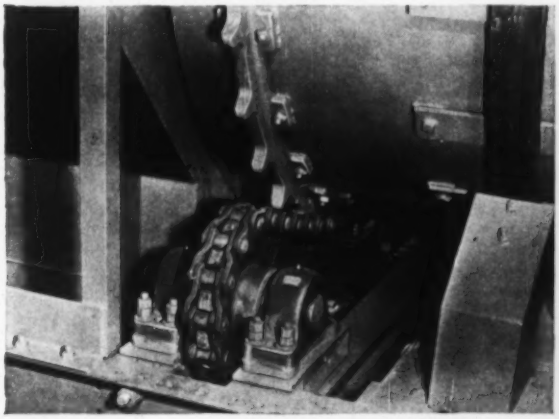
"FULL-ROUND" BUSHINGS are properly hardened to shrug off shock, resist wear . . . accurately sized for controlled press fit to prevent rotation in sidebars.

Greater live bearing area extends life

Stress concentration points are eliminated in Link-Belt LXS chain! "Full-round" design avoids sharp corners which may be the starting points of chain failure . . . provides maximum live bearing area between pin, bushing and sidebars. As a result, stress is distributed evenly . . . long chain life is assured under severe conditions.

Pins and bushings of LXS chain are accurately sized . . . assuring controlled press fits, preventing rotation in sidebars. Similar accuracy in machining of sidebars permits close control of pitch and proper chain length after assembly.

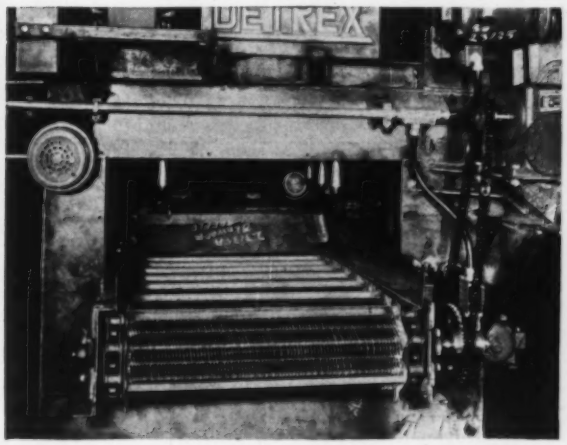
Other long-life features of Link-Belt LXS chain include use of selected steels and controlled hardening of all parts. Both contribute to greater endurance . . . greater uniformity.



LXS drives stand up to impact and abrasive service

Large, live bearing area makes LXS chain ideal for exposed drives and abrasive conditions such as found on this heavy rotating drum. Uniform distribution of load over ample bearing area reduces cutting action of abrasives . . . extends chain life.

LXS chain has stamina required for long, heavy-duty conveyors



With its exceptional strength and wear resistance, Link-Belt LXS chain can easily meet rugged conveying and elevating requirements. Due to accuracy of pitch and attachment spacing, plus close matching of multiple strands, LXS has the added strength and wear life necessary for the extra-long conveyors so important to today's highly mechanized industry.

HEADQUARTERS for chains, sprockets and other Link-Belt products is your nearby Link-Belt factory branch store or authorized stock-carrying distributor. Refer to the Yellow Pages of your local Phone Directory.

LINK-BELT

14,740

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LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

POWELL

world's largest family of valves

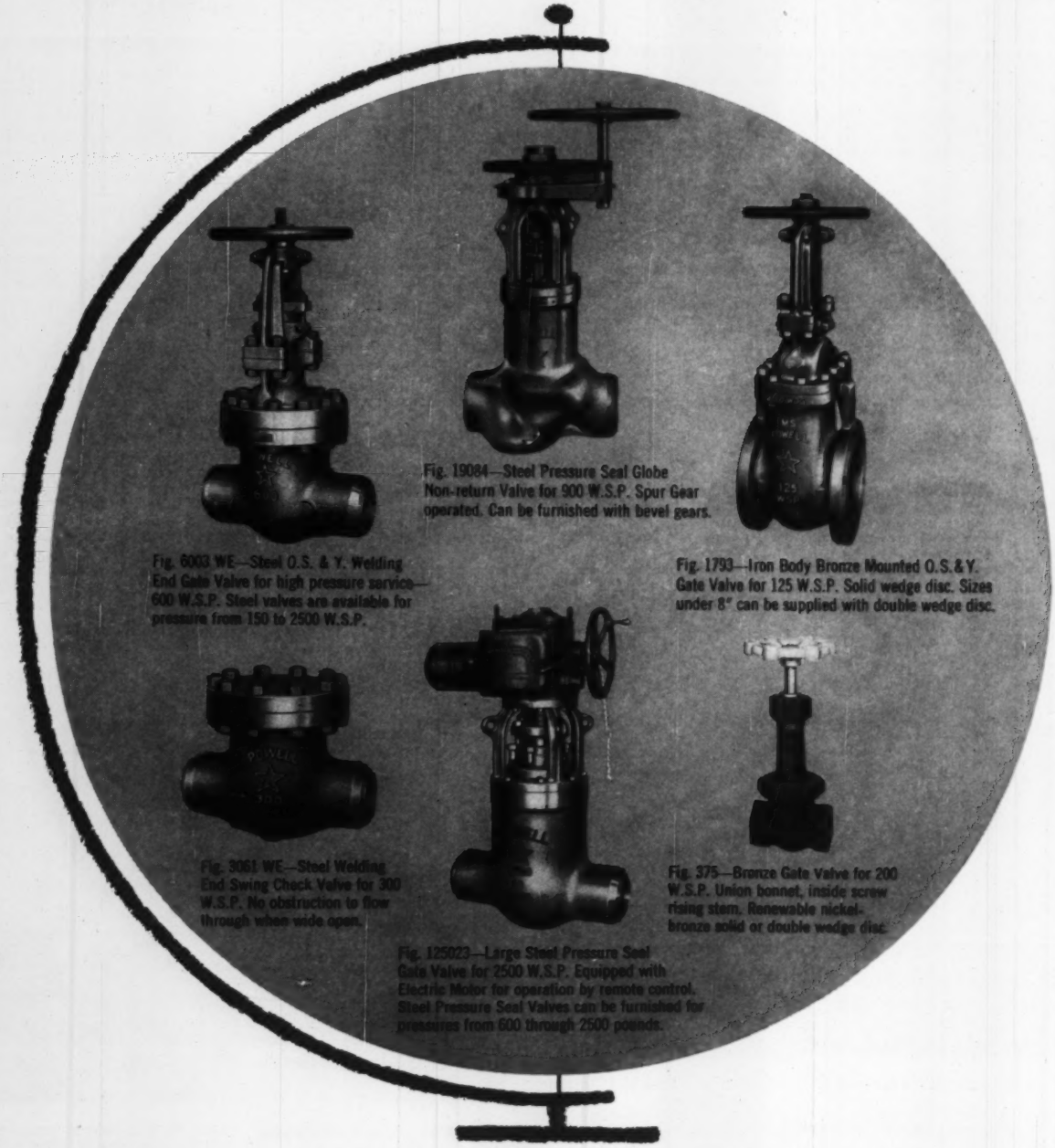


Fig. 19084—Steel Pressure Seal Globe Non-return Valve for 900 W.S.P. Spur Gear operated. Can be furnished with bevel gears.

Fig. 6003 WE—Steel O.S. & Y. Welding End Gate Valve for high pressure service—600 W.S.P. Steel valves are available for pressure from 150 to 2500 W.S.P.

Fig. 1793—Iron Body Bronze Mounted O.S.&Y. Gate Valve for 125 W.S.P. Solid wedge disc. Sizes under 8" can be supplied with double wedge disc.

Fig. 3061 WE—Steel Welding End Swing Check Valve for 300 W.S.P. No obstruction to flow through when wide open.

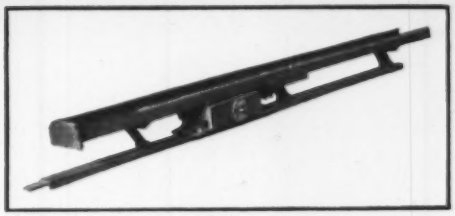
Fig. 125023—Large Steel Pressure Seal Gate Valve for 2500 W.S.P. Equipped with Electric Motor for operation by remote control. Steel Pressure Seal Valves can be furnished for pressures from 600 through 2500 pounds.

Fig. 375—Bronze Gate Valve for 200 W.S.P. Union bonnet, inside screw rising stem. Renewable nickel-bronze solid or double wedge disc.

FOR EVERY FLOW CONTROL PROBLEM Powell offers more kinds or types of valves, available in the largest variety of metals and alloys, to handle every flow control requirement. Your local valve distributor will be glad to tell you all about them. Or write to us for the full facts.

THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**

SHOT BLAST ROOM at E. W. Bliss Company, Canton, Ohio. Jeffrey LMV Conveyors, furnished through Northeastern Supply Company, gather shot and carry it back to screens and pressure tank for re-use.



Another good spot for time-saving, cost-saving

JEFFREY LMV CONVEYORS

In all kinds of plants, the handling of light materials can be speeded up, made simpler, more efficient and economical . . . with right-from-distributor-stock Jeffrey LMV Conveyors. Compact LMV mechanical vibrating units are quickly custom-sized for your installation . . . ready for next-day delivery and easy for plant personnel to install.

In shot blast room above, five 12″ x 25′ 3″ LMV units beneath roll-in platform automatically gather shot. A 26′ 3″ unit along the back carries it to screens and pressure tank for re-use.

Jeffrey LMV Conveyors are inexpensive, built for round-the-clock service and quiet in operation. They provide efficient, automatic handling of all types of light materials . . . give long trouble-free service. Get complete information from your distributor or write The Jeffrey Manufacturing Company, 915 North Fourth Street, Columbus 16, Ohio.

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PLUS CASH AWARDS IN 1958

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$150 cash award and trips to Detroit and New York

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4 POSTGRADUATE STUDENT AWARD

$25 cash prize plus trip to New York for best paper on an engineering subject

for rules covering eligibility, preparation and closing dates for these awards

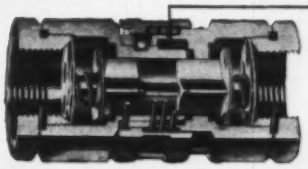
CONSULT YOUR FACULTY ADVISER NOW!

WHICH SNAP-TITE QUICK-CONNECT COUPLING IS BEST FOR YOU?

SNAP-TITE "H" COUPLING . . . . . FOR HIGH PRESSURE APPLICATIONS

FOR HYDRAULIC OR AIR

"H" Coupling for high strength, higher efficiency, high-resistance to heavy line surge. Sizes: ⅛" thru 12". Bulletin No. 240

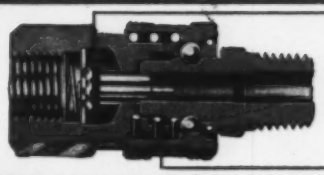


Exclusive U-packer gives a positive seal without compression set because of rubber distortion. Line pressure inside the U-packer keeps it open and forced against its metal backing—the higher the pressure, the tighter the seal.

SNAP-TITE HI-FLOW COUPLING . . . FOR LOW PRESSURE APPLICATIONS

FOR AIR AND FLUIDS UP TO 150 p.s.i.

Hi-Flow is recommended to connect small air tools to plant air system, and for low pressure fluid transfer in small lines.
Sizes: ⅛" thru ¾". Bulletin No. 230

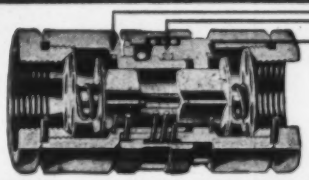


Bonded valve washer
(pat. pending on valve construction)

Exclusive U-packer

SNAP-TITE "HK" COUPLING . . . . . FOR HARD TO HANDLE FLUIDS

FOR FUMING ACIDS, ALKALIES, SOLVENTS, AND HIGH PRESSURE STEAM . . . "HK" is the only coupling now on the market for fluid temperatures from −100° F to +500° F . . . and for live steam up to 460° F. Its seals are made of Teflon for which there is no known solvent.
Sizes: ½" thru 3". Bulletin No. 270



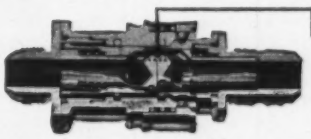
Teflon Valve Seal

Teflon Nipple Seal

Teflon Valve Seal

SNAP-TITE NO-SPILL COUPLING . . . FOR MINIMUM AIR INCLUSION

FOR AIRCRAFT, MISSILE HYDRAULIC, FUEL SYSTEMS which cannot stand air in the lines, and for transmitting fluids which *must not spill*, the Snap-Tite no-spill coupling is recommended.
Bulletin No. 280

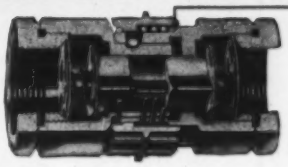


Flush valves prevent spillage, air inclusion. Snap-Tite will engineer special variations to your requirements.

SNAP-TITE "E" COUPLING . . . . . FOR VACUUM and VERY LOW PRESSURE

FOR VACUUM SYSTEMS IN THE MICRON RANGE

"E" Coupling performs in the *micron* range in the smaller sizes both connected and disconnected. Recommended, too, for gravity flow . . . U.L. approved for LP Gas.
Sizes: ⅛" thru 12". Bulletin No. 250



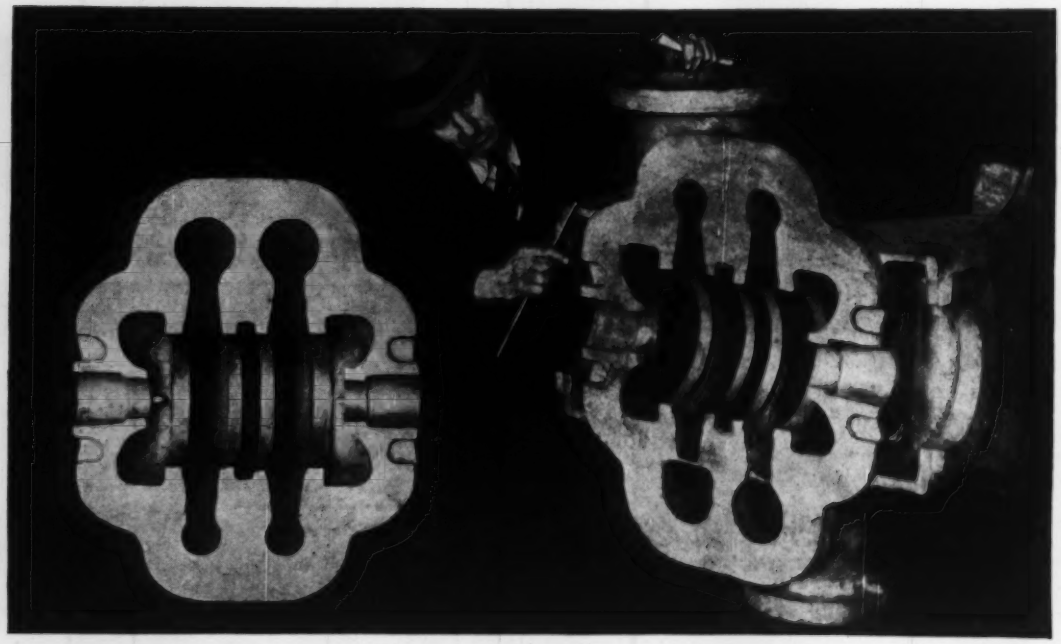
Nipple seals in coupler by depressing the lip of the E packer and slightly compressing the body of the packer. This new E-packer gives positive seal under high-pressure, low-pressure, and vacuum.

Snap-Tite Couplings are available plain, (without valves), and with either single or double shut-off. Couplings normally furnished in alloy steel, but all (except hi-flow) are also available in brass, aluminum, or stainless steel with a variety of finishes.

SNAP-TITE, INC., UNION CITY 4, PA.

Snap-Tite

SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS



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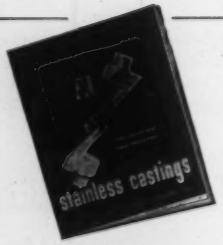

Write for this book on A-L STAINLESS STEEL CASTINGS

28 pages of valuable and complete data on stainless castings: analyses, properties, technical data on handling and heat treatment, typical applications, how to order, etc.

ADDRESS DEPT. ME-2

Odd shapes or intricate sections are certainly no problem—look at some of our stainless steel casting products illustrated above. We could show you hundreds more. And size is no consideration, either—we're equipped to handle any stainless castings—from a few ounces to thousands of pounds.

The really important point for you to consider is not the matter of shape or size, but of *experience*. The A-L Buffalo Foundry is a group of specialists in high-alloy steel castings *exclusively* . . . pioneers in both the static and vertical-centrifugal methods of casting stainless steels.

For your assurance, there's a long record of years of successfully answering difficult service conditions with sound, clean-grained Allegheny stainless castings—free from defects, easy to machine and dependable in supply.

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. . . Fluid Power news

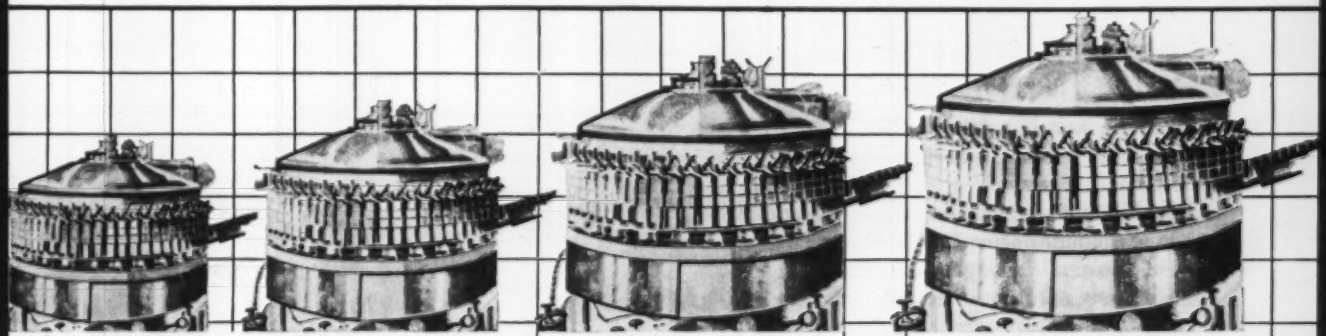
REPORT No. 11,301
HYTAC IMPROVES FILL-CLOSE PRODUCTION

From Oilgear Application-Engineering Files

HOW OILGEAR HYTAC DRIVES IMPROVE FILLER-CLOSER PERFORMANCE—TRIPLE OUTPUT

CUSTOMER: *A Large Food Machinery Manufacturer (Name withheld by request)*

DATA: This manufacturer called upon Oilgear to help solve the problem of producing a filling and closing machine that would exceed the mechanical drive limitations reached when the fill-close rate was increased from 150 to 360 12-oz cans per minute. *Summary of User Requests:* A fill-close rate of at least 425 12-oz cans per minute; accelerate to half speed in 2 seconds—to full speed in 5 seconds without jerky, jack rabbit starts that strain the equipment; reduce spillage and "deadheads"; decelerate to stop in 0.4 seconds; reduce costly losses due to under or overfilling; change speed instantly, easily—with remote control preferred; accurately hold any selected speed regardless of load or electric power variations—viscosity changes; impervious to daily sanitary washdowns; provide trouble-free, low-maintenance, continuous operation.



Average normal mechanical drive—150 12-oz cans per minute.

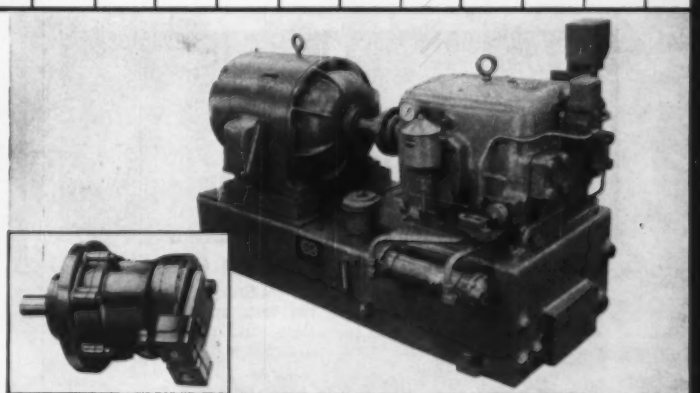
Mechanical drive limit—360 12-oz cans per minute.

1955—Oilgear heavy-duty, Size 20, Any-Speed HYTAC drive—to 600 12-oz cans per minute with improved performance.

1957—Oilgear heavy-duty, Size 35, Any-Speed HYTAC drive—to 1200 12-oz cans per minute with improved performance.

OILGEAR SOLUTION #1 (1955) Oilgear heavy-duty, Size 20, Any-Speed HYTAC (hydraulic tachometer) drives provided the first step in meeting user requests. These drives on a 6-spindle closer and 60-spout filler smoothly accelerated to full speed in 2 seconds—decelerated to stop in 0.2 seconds; a new, high fill-close rate—to 600 12-oz cans per minute without machine redesign; held *any* preselected speed within ± 0.5% regardless of load, electric power variations or viscosity changes—assuring uniform fill; reduced spillage and conveyor jams. Oilgear heavy-duty HYTAC simplified machine design and reduced maintenance by eliminating slip clutches and electric brakes—and by providing hydraulic cushioning; hydro-dynamic braking; automatic, positive protection against starting and running overloads. Remote, space-saving pump and motor location and completely sealed, leak-tight system provided protection to daily, sanitary washdowns. Users liked this improved performance and speed . . . over 50 similar installations have been made. Some users, however, continued to request higher production rates—with all of HYTAC's advantages.

OILGEAR SOLUTION #2 (1957) Due to the proven ability of Oilgear application-engineered, heavy-duty, drive and control systems to help meet user demands, this manufacturer naturally turned to Oilgear for further engineering teamwork in meeting new, greater production requirements. *RESULT*—new, higher production filling-closing machines that TRIPLE original mechanical drive output—to 1200 12-oz cans per minute with all the same desirable features outlined in the previous installations. One important addition has been made . . . new user satisfaction.



This is the newest Oilgear Power-Pak for filler-closers—Oilgear heavy-duty, Size 35 HYTAC drive components. Unit can be remotely mounted and remotely controlled for new performance, new production speed, new accuracy.

Here is but one reason and proof why designers and builders of machinery turn to Oilgear . . . why users recognize and trust the name . . . why more and more this phrase is heard, "For the lowest cost per year—it's Oilgear!"

For practical solutions to YOUR linear or rotary drive and control problems, call the factory-trained Oilgear application-engineer in your vicinity. Or write, stating your specific requirements, directly to

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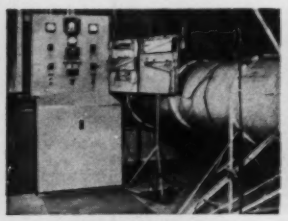

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Published December 1957

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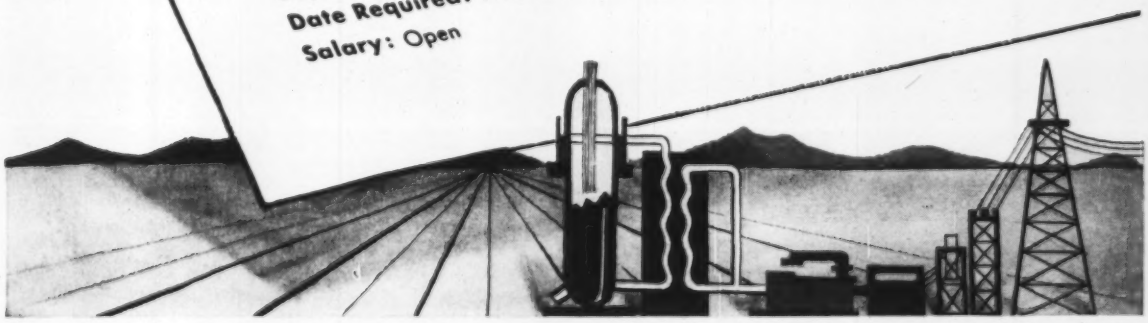

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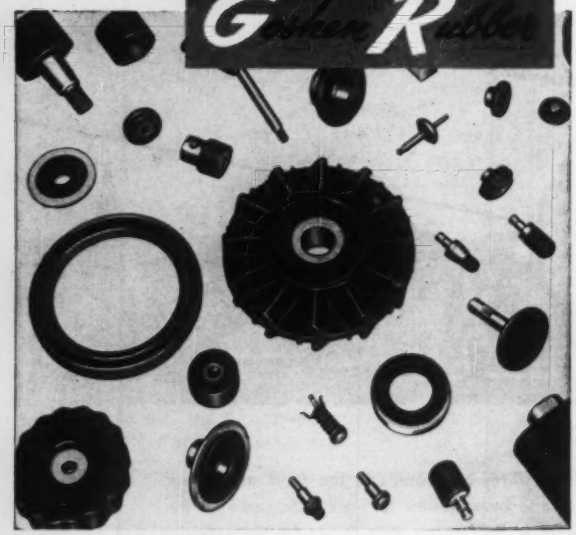

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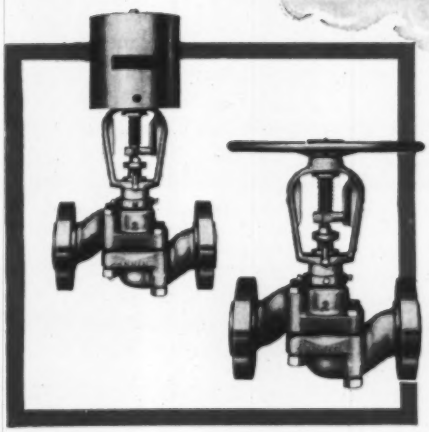

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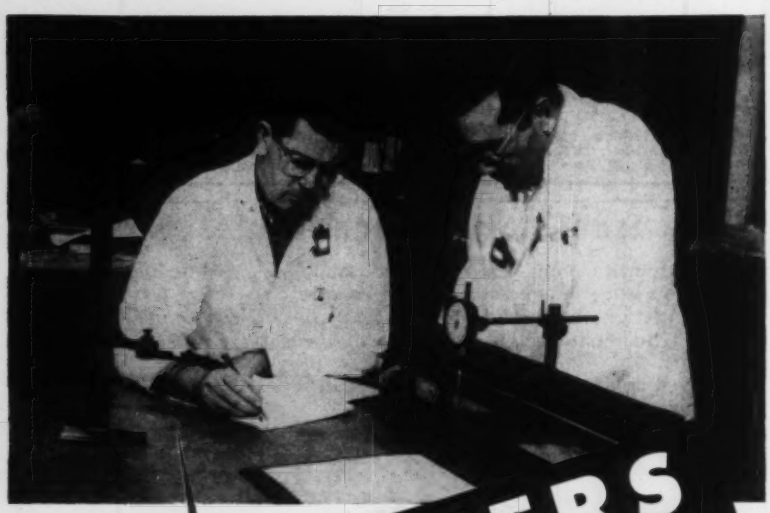

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Here Staff Scientist Bernard Ellis, Flight Sciences Division (center), discusses problems relating to accurate positioning of a vehicle in the upper atmosphere with J. F. Houle, left, and J. J. Donhan.

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MECHANICAL ENGINEERING
January, 1958 CARD INDEX Vol. 80, No. 1

Design by Logic—Automatic Chemical Batching, J. P. Laird	38
The Builders of ECPD, C. E. Davies	42
Standard Sizes of Shipping Containers for Cargo Interchange, H. H. Hall	44
Boiler Feed Pumps for Supercritical Pressure, Hans Gartmann	51
Developing an Aircraft Gas Turbine, M. S. Saboe	55
Computer Control of Machine Tools, G. M. Reynolds	59
Editorial	35
Briefing the Record	61
Photo Briefs	72
European Survey	74
ASME Technical Digest	76
Review of Books	124
Books Received in Library	124
The Roundup	126
The ASME News	132

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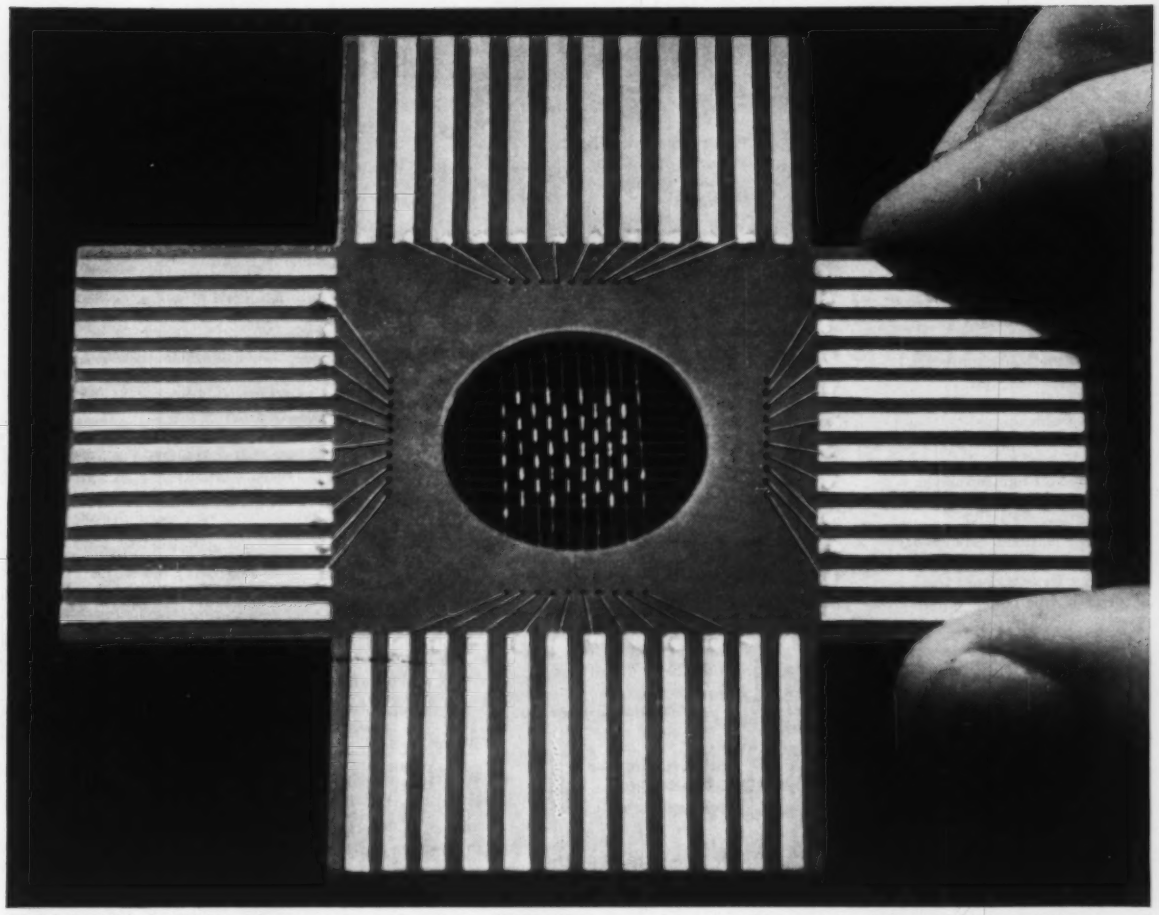

Model (simplified) illustrates basic structure of magnetic "Twistor" memory—magnetic and copper wires interwoven as in a window screen. Twisted condition of the magnetic wire shifts preferred direction of magnetization from a longitudinal to a helical path. One inch of twisted wire, thinner than a hair, can store as much information as ten ferrite rings. "Twistor" was invented at Bell Laboratories by Andrew Bobeck, M.S. in E.E. from Purdue University.

New twist in memory devices

An ingenious new kind of magnetic memory has been developed by Bell Laboratories scientists for the storage of digital information. Known as the "Twistor," it consists basically of copper wires interwoven with magnetic wires to form a grid.

"Twistor" gets its name from a characteristic of wire made of magnetic material. Torsion applied to such a wire shifts the preferred direction of magnetization from a longitudinal to a helical path. This helical magnetization has been applied to produce a magnetic storage device of unprecedented capacity for its size.

In a magnetic memory, information is stored by magnetizing a storage element. In conventional memories the storage elements consist of rings of ferrite. In the "Twistor," they consist of tiny segments of hair-thin magnetic wire. At each intersection of the grid, one such segment is capable of storing a binary digit.

The "Twistor" is simple and economical to fabricate, and its minute energy requirements are easily supplied by transistor circuits. Bell Laboratories engineers see important uses for it in future telephone systems which demand the compact storage of much information, as well as in digital computers for civilian and military applications.

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INDEX TO ADVERTISERS

Acme Chain Corp. 163
*Aerovent Fan Co. 210
*Air Preheater Corp. 49
Ajax Flexible Coupling Co. 162
All American Tool & Mfg. Co. 186
*Allegheny Ludlum Steel Corp. 208
Allen-Bradley Co. 195
Allied Chemical & Dye Corp.
Nitrogen Div. 220
*Allis-Chalmers Mfg. Co. 218
*American Blower
Div. American-Standard 190
*American Brass Co. 187
*American Pulverizer Co. 162
ASME Publications 196, 210
Mechanical Catalog 210
Anker-Holth Div.,
Wellman Engineering Co. 21
Annin Co. 215
Arcos Corp. 175
Argonne National Laboratory 193
*Armstrong Machine Works 51
Atomics International Div.,
North American Aviation (Inc.) 173, 180

*Babcock & Wilcox Co.
Boiler Div. 2nd Cover
Tubular Products Div. 4
*Bailey Meter Co. 192
Barco Mfg. Co. 179
Bell Telephone Laboratories 225
Bituminous Coal Institute 10, 11
*Blaw-Knox Co.
Power Piping & Sprinkler Div. 12
Bridgeport Thermostat Div.,
Robertshaw-Fulton Controls Co. 166
*Buffalo Forge Co. 216
Bundy Tubing Co. 31
*Bunting Brass & Bronze Co. 184
Bushings (Inc.) 212

C.E.M. Co. 18
Chace, W. M., Co. 178
Cincinnati Gear Co. 182
Clarage Fan Co. 28
Cleveland Worm & Gear Co. 199
*Columbia-Geneva Steel Div. 26, 27
*Combustion Engineering (Inc.) 47, 218
Cone-Drive Gears Div.,
Michigan Tool Co. 20
*Consolidated Chimney Co. 172
Crane Co. 29

Denison Engineering Div.,
American Brake Shoe Co. 201
*Detroit Stoker Co. 19
*Diamond Power Specialty Corp. 177
*Dresser Industries (Inc.)
Roots-Connersville Blower Div. 25
Dudek & Bock Spring Mfg. Co. 185
Duff-Norton Co. 154
duPont deNemours, E. I., & Co. 221

Eagle Pencil Co. 24
Edward Valves (Inc.)
Sub. Rockwell Mfg. Co. 16, 17

*Falk Corp. 22
Farrel-Birmingham Co. 211
*Flexonics Corp. 149
*Foxboro Co. 13
Frick Co. 169

*Gear Specialties (Inc.) 2
General Radio Co. 189
Goshen Rubber Co. 214
*Grinnell Co. 197

Heim Co. 228
*Homestead Valve Mfg. Co. 151
Houdaille Industries (Inc.)
Manzel Div. 161
*Hyatt Bearings Div.,
General Motors Corp. 40

Imperial Tracing Cloth 214
International Nickel Co. 54

Jeffrey Mfg. Co. 205
Jenkins Bros. 152
Jet Propulsion Laboratory
Div. Calif. Inst. of Technology 222
Jordan Corp.
Div. OPW Corp. 174

Kellogg, M. W., Co. 227
Keuffel & Esser Co. 181
Koh-I-Noor Pencil Co. 164
Koppers Co. (Inc.)
Fast's Coupling Dept. 200

Link Aviation (Inc.) 180
*Link-Belt Co. 203
Lockheed Aircraft Corp. 219

McDonnell & Miller (Inc.) 172
Marquardt Aircraft Co. 158, 159
Marsh Instrument Co.
Affil. James P. Marsh Corp. 50
Maryland Shipbuilding &
Drydock Co. 48
*Mercoid Corp. 170

National Airoil Burner Co. 170
New Departure Div.,
General Motors Corp. 1
*New York Blower Co. 165
Nordberg Mfg. Co. 41

Ohio Injector Co. 3rd Cover
*Oilgear Co. 209

*Pangborn Corp. 45
Pantex Mfg. Corp. 176
*Philadelphia Gear Works 39
Pittsburgh Lectrodryer Div.,
McGraw-Edison Co. 46
Pittsburgh Piping & Equipment Co. 188
Powell, William, Co. 204
Precision Rubber Products Corp. 23

Raybestos-Manhattan (Inc.)
Packing Div. 156, 157
*Republic Flow Meters Co.
Sub. Rockwell Mfg. Co. 14, 15
Rhopac (Inc.) 212
Ric-Wil (Inc.) 52
Robertshaw-Fulton Controls Co.
Bridgeport Thermostat Div. 166
Rockford Clutch Div.,
Borg-Warner 183
*Roots-Connersville Blower Div.,
Dresser Industries (Inc.) 25
Rust-Oleum Corp. 191

Shenango Furnace Co. 171
Snap-Tite (Inc.) 207
*Southwest Products Co. 214
Spraying Systems Co. 185
Stephens-Adamson Mfg. Co. 6, 7
Stewart-Warner Corp.
Alemite Div. 223

*Tennessee Coal & Iron Div. 26, 27
*Terry Steam Turbine Co. 202
Thomas Flexible Coupling Co. 176
Timken Roller Bearing Co. 4th Cover

*United States Graphite Co.
Div. Wickes Corp. 8, 9
United States Pipe & Foundry Co. 42, 43
*United States Steel Corp. 26, 27
*United States Steel Export Co. 26, 27
Universal Drafting Machine Corp. 186

Virginia Gear & Machine Corp. 39
*Vogt, Henry, Machine Co. 44
*Voss, J. H. H., Co. 212

Westinghouse Electric Corp.
33–38, 160, 213
Sturtevant Div. 198
Wiegand, Edwin L., Co. 174
Winsmith (Inc.) 155

*Yarnall-Waring Co. 147
Yoder Co. 30
*Yuba Heat Transfer Div.,
Yuba Consolidated Industries (Inc.) 32

*Zallea Brothers 53

* The asterisk indicates that firm has product catalog in the 1958 Mechanical Catalog.

Your attention is directed to

Keep Informed 153–186
Consulting Service 224
Opportunities 217–222

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- *Coated electrode welding in the shop*
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- *Streamlined forged fittings*
- *Development of an integrated analytical solution for piping flexibility analysis to include multiple anchor and intermediate restraint problems*
- *Use of inversion procedures for piping flexibility analysis*
- *Development of model testing method for solving piping flexibility procedures*
- *Evaluation of stress range concept and fatigue basis for flexibility design*
- *Development of material specifications for C. ½% Mo. pipe having #3-#5 actual grain size to give optimum strength at high temperatures*
- *Kelcaloy bi-metallic transition or "K" pieces to join ferritic to austenitic piping*

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HEIM UNIBAL SPHERICAL BEARINGS and ROD ENDS supply the exact type of linkage, mounting, and degree of misalignment correction required by this engine, and The Heim Company is proud of its contribution to the success of the GE J79.

There are over 200 Unibal Rod Ends assembled with the variable pitch stator blade operating levers.

There are over 50 LS type Unibal Spherical Bearings used as pivot points for the inlet guide vanes.

The bearings which mount the engine to the airframe are three Heim Unibal cartridge units. These bearings carry the entire weight of the engine *and its thrust*.

Other Heim bearings of various types used on this engine bring the total to around 500.

* * * *

The load carrying capacity of Unibal spherical bearings is very high. They are applicable in any linkage where motion must be transmitted at constant or varying angles. They are ideal as supports to any device which is subject to mechanical or thermal deflection.

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THE HEIM COMPANY, FAIRFIELD, CONNECTICUT

Safe, Tight ...Trouble-free

. . . with *union* body-bonnet joint on 125 lb., 150 lb., 200 lb. pressure classes

Be safer—and save! Greater operating safety, positive shutoff, and low upkeep costs are the prime advantages of modern OIC bronze gate valve designs in all pressure classes.

Union ring nut provides safety-tight body-bonnet joint

The separate union nut seals the bonnet and body mating surfaces, effecting a tight, leak-proof joint. Possibility of distorting body and bonnet during disassembly and assembly and of loosening the joint during operation are virtually eliminated.

OIC design reduces maintenance costs

Necessity for stem replacement can be forgotten, because stems are special, long-lived OIC *Alloy-40*. This sturdy material eliminates galling and seizing and contributes to easy operation.

Stem threads are never exposed to line fluids in open or closed positions (125 lb. and 150 lb.), preventing thread abrasion from line fluids or suspended solids.

All pressure parts are designed for maximum strength, and working parts are hydrostatically tested for positive sealing and seating. Write for our folder, No. 1006. ***Order from your OIC distributor.***

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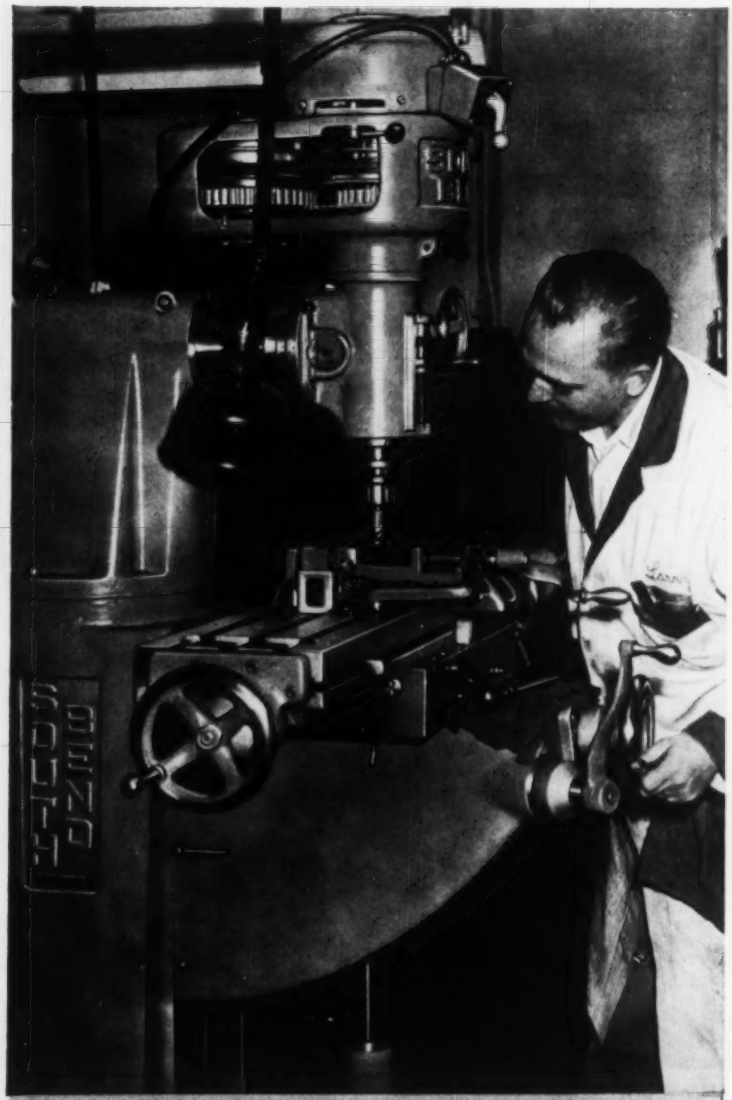
Precision milling machine spindle gets extra precision with TIMKEN® bearings



SOUTH BEND LATHE WORKS mounts the adjustable spindle of their vertical precision milling machine on two Timken tapered roller bearings to give it extra accuracy in any position. They also use Timken bearings in the elevating screw mechanism.

AT all eight speeds and at any angle, this vertical milling machine mills, drills and bores to fine tolerances. And to give the spindle extra precision in every position, South Bend Lathe Works mounts it on two Timken® tapered roller bearings. These Timken bearings:

HOLD THE SPINDLE RIGID AT ANY ANGLE. Regardless of operating position and work loads, Timken bearings keep the spindle in positive alignment. Their tapered design lets them take *both* radial and thrust loads in any combination.

TAKE HEAVY LOADS, RESIST WEAR. Full line contact between rollers and races gives Timken bearings load-carrying capacity to spare. And both rollers and races are case-carburized to give them hard, wear-resistant surfaces over tough, shock-resistant cores. They last longer, reduce maintenance.

CUT MAINTENANCE COSTS. Timken bearings hold shafts concentric with their housings. Dirt stays out; lubricant stays in. They are geometrically designed to roll true, precision-made to make sure they do. We even make our own steel. No other American bearing manufacturer takes this extra step to insure the highest quality.

Whether you buy machines or build them, make sure you get the best bearings. Look for the trade-mark "TIMKEN". The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

TIMKEN BEARING EQUIPPED

This symbol on a product means its bearings are the best.

TIMKEN *TAPERED ROLLER BEARINGS ROLL THE LOAD*

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